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Dayna Hilliard

Fanshawe College of Applied Arts and Technology

William Johnston

Fanshawe College of Applied Arts and Technology

Alan M. Batt

Fanshawe College of Applied Arts and Technology

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AN INTRODUCTION TO TROPICAL MEDICINE FOR PARAMEDICS

Dayna Hilliard PCP1,2, C. William Johnston BA(Hons.) PCP1,2, Alan M. Batt MSc CCP1,3,4

1. Paramedic Programs, Fanshawe College, Ontario, Canada.
2. Ottawa Paramedic Service, Ontario, Canada.
3. Department of Community Emergency Health and Paramedic Practice, Monash University, Victoria, Australia.
4. Paramedic Science Discipline, CQUniversity, Queensland, Australia.

Introduction

With the increasing presence of paramedics as healthcare providers, many times as the sole medical provider in remote areas,[1] on offshore facilities, humanitarian missions, remote oil and gas facilities,[2,3] and as medics in close protection teams in high-risk areas, as well as at large scale gatherings that carry a history and an increased risk of disease outbreaks [4], the need for non-traditional, specialised education is becoming increasingly apparent. One specialty area of medical practice not commonly addressed in traditional paramedic education is that of tropical diseases and tropical medicine.

While a paramedic working in most Western countries is unlikely to encounter these conditions regularly in clinical practice, there are now situations where members of the increasingly globally-mobile paramedic workforce may find themselves facing these case presentations. Presented here is a brief overview of major tropical diseases for paramedics, including the big three (malaria, HIV/AIDS and tuberculosis), as well as cholera, yellow fever and tetanus, along with treatment recommendations. We have previously discussed Zika Virus Disease in detail, and we will discuss the neglected tropical diseases (NTDs) in a future article. As always, up-to-date medical reference material and local clinical guidelines should be followed in all cases where medical treatment is delivered.

General advice

When interacting with patients in remote/distant settings or patients that have recently travelled, a detailed recent travel history, including prophylaxis and vaccinations should form part of the paramedic history taking in anyone with a suspected travel related illness.

In patients that have travelled recently, you may be unfamiliar with diseases present in those areas. Your patient may have knowledge regarding diseases they were warned about before or during their travels and the CDC and WHO websites are a great resource to search current warnings and pathogens to be aware of based on location.

In general, any fever in the returned traveller should be taken seriously and further investigated. Always take PPE precautions to protect yourself and your patient and to prevent spread of disease between colleagues, healthcare staff and patients. You may have a wide range of working differentials and may be left treating symptoms as they appear; often many tests will need to be performed and depending on incubation periods they may come back negative at first even if the patient is infected.

Infant mortality from many of these diseases is high – a child dies from malaria every two minutes for example – and children should always be triaged and treated immediately. [5] When working overseas or in areas with high rates of disease, patient education is a great way to reduce or prevent the acquisition or spread of many diseases. Knowing how a disease is contracted and how it is spread is useful information that can be passed on to the local population. Lastly, never feel discouraged to ask for help and use your colleagues and others as resources!

Malaria

Background & incidence

Human malaria is caused by four species of parasitic protozoa, *Plasmodium falciparum*, *Plasmodium vivax*, *Plasmodium ovale*, and *Plasmodium malariae*, which are transmitted by *Anopheles* mosquitoes (vector). It is endemic

throughout tropical areas of the world, infecting at least 200 to 500 million people annually in 91 countries, and resulting in 1 to 2 million deaths. *P. falciparum* is the most severe and life threatening type of malaria.[5]

This disease is preventable and curable as long as it is recognized and treated effectively. Africa has the highest rate of malaria, with almost 90% of reported cases and 92% of all malaria deaths from this area.[5] Other areas that are at risk of malaria are South-east Asia, Latin America and the Middle East. With increased awareness and prevention rates of malaria and malaria caused deaths are slowly decreasing. In the areas with high rates of transmission, approximately 70% of malaria caused deaths are in children under 5 years of age as they are highly susceptible to infection and illness.[5] However, there is some good news: between 2000 and 2015, malaria incidence rates (new malaria cases) fell by 37 % globally, and by 42 % in Africa.[6]

Transmission

Transmission occurs through the bites of female *Anopheles* mosquitoes between dusk and dawn. Intensity of transmission depends on the parasite, the vector, the human host and the environment. The parasite is found in red blood cells, thus it can be transmitted through blood transfusions, organ transplants, shared needles/syringes or intrauterine. Malaria cannot be spread human to human through personal contact. Groups who are most at risk are: infants, children under 5 years, pregnant women, people with HIV/AIDS, immigrants, mobile populations and travellers. Fortunately in many locations the risks of malaria are only seasonal. The best way to diagnose malaria is through blood smears, although there are dipstick antigen tests available.



Prevention

Prevention of malaria transmission is a high priority. If travelling to a setting with a high incidence of malaria, travellers should consult their doctor four to six weeks prior to travelling for required inoculations and prescription of antimalarial drugs as preventative measures. A vaccine is currently available against *Plasmodium falciparum* malaria.[7] Many people who live in areas with high rates of malaria often have some acquired immunity due to increased exposure; though they still may become infected, this exposure may prevent them from becoming severely ill. Pregnant women should avoid travelling to high risk areas as malarial infections can cause pregnancy issues such as premature delivery, miscarriages or stillbirths. Fortunately, many drugs used to treat malaria are safe to consume if pregnant.

The best way to prevent malaria transmission is to prevent mosquito bites – this is known as vector control. This can be done by using insect repellents, avoid being outside between dusk and dawn (most disease transmitting vectors are active during this period), wearing long sleeved clothing at night, use of insecticide treated mosquito nets and performing indoor residual spraying.

Signs & symptoms

Typical signs and symptoms are fever and flu like symptoms. Patients often present with chills, headache, muscle aches or fatigue. Nausea, vomiting, and diarrhea may be present and patients may be anemic or jaundiced. Patients may not always have the typical malarial paroxysms of fever and chills, and instead they may present with nonspecific symptoms such as fatigue, diarrhoea, headache, myalgia, or sore throat. If the infection is not treated, malaria can progress to renal failure, confusion, seizures, coma or death. Signs and symptoms usually will begin to occur anywhere from 10 days to 4 weeks after infection but can be as late as 1 year post infection.

Management

Prehospital care priorities for the patient with malaria include correction of dehydration, pyrexia, hypoglycemia, and acidosis. Patients may present in respiratory distress due to metabolic acidosis, severe anemia and severe lung infections due to decreased immune function. Chloroquine is the drug of choice for infections with chloroquine-susceptible malarial parasites. Chloroquine-resistant *P. vivax* infections can be treated with quinine or quinidine in conjunction with doxycycline.

Tuberculosis

Background & incidence

Tuberculosis (TB) is caused by a bacterial infection with *Mycobacterium tuberculosis*. Annually, approximately 8.7 million people are

infected with TB worldwide, many who remain asymptomatic. The infection can lie dormant in infected persons for many years, and can reactivate during periods of stress or immunosuppression. Pulmonary infection is the most common presentation, however, patients can present with extrapulmonary TB infection in areas such as the lymph nodes, kidneys, pericardium and meninges.

Transmission

TB is spread through airborne transmission from someone infected and sick. A diseased person can spread the bacteria through coughing, sneezing or singing and usually only those in close contact are at risk. TB cannot be spread by shaking hands, sharing food/drink, touching clothing/fabrics or by kissing. It is possible to come into contact with TB without becoming symptomatic (latent infection). Some patients can become unwell weeks, months or even years later when immunocompromised.

If exposed, it is common to have symptoms occur between 2-12 weeks after exposure and if a patient has a latent infection they are at the highest risk of it progressing to an infection within the first few years. It is recommended to have latent infections treated. At risk groups for infection include those who have had close contact with an infected person, immigrants from places with high rates of TB, groups of people with increased transmission rates

(homeless, IV drug users and those with HIV) and people who work closely with groups of people that have an increased transmission rates (hospitals, shelters, prisons, nursing homes). Those who are at risk of being immunocompromised such as those with comorbidities, receiving chemotherapy or taking certain medications are also at an increased risk.

Signs & symptoms

Common signs and symptoms of pulmonary TB include a cough persisting for over three weeks, which may be productive (blood or sputum), and may be associated with chest pain, weakness, fatigue and weight loss (often due to loss of appetite). Often, the patient will have a fever, accompanied by chills and night sweats. Extrapulmonary TB symptoms depend on the organs or system affected.

Provider safety

The use of PPE or respiratory devices is recommended such as a properly fitted N95 mask. Providers should have a TB test conducted before travelling, and again 8-10 weeks after returning. Avoid areas of poor ventilation or with recirculation of air. As a health care provider if you are providing care for someone who is infected or possibly infected with TB it is recommended to separate them from other patients if possible. Collect a thorough history of possible TB exposure/infection, identify any signs or symptoms of infection and investigate

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their medical history for conditions that may put them at an increased risk of infection.

If you are managing a patient's airway ensure you wear eye protection and a face shield and if intubation is required, attach a bacterial filter to the ETT. Ensure there is increased ventilation in the ambulance or clinic and have as much outdoor airflow through as possible. Inform receiving hospitals of the patient's disease or possible infection; hospitals may have an AII (airborne infection isolation) room to adequately isolate the patient. Most importantly ensure to adequately disinfect hands, equipment and ambulance between all patients.

Management

There are multiple treatment options for TB, selection of an appropriate agent varies based on whether it is a latent infection, active infection, a patient who also has HIV, or a pregnant patient or a child. The treatment options of an antimicrobial or a combination of antimicrobials will be administered over a 6-9 month period.

HIV and AIDS

Background & Incidence

The Human Immunodeficiency Virus (HIV) is a retrovirus that attacks the body's immune system, specifically CD4 T cells, weakening the body's ability to fight off infections and some types of cancers. As the infection continues to destroy and impair immune function, individuals become immunodeficient. If HIV is left untreated it leads to the development of Acquired Immunodeficiency Syndrome (AIDS), the most advanced stage of HIV infection, defined by the development of infections and some cancers. Once infected with HIV individuals carry it for life.

The WHO estimates that there are 30.8 – 42.9 million individuals living with HIV in 2016, with 1.6 – 2.1 million new infection that year. They report 800,000 – 1.2 million deaths as a result of AIDS in 2016.8

Transmission

HIV is spread through mucus membrane or open tissue contact with bodily fluids such as blood, semen, genital fluids or breast milk. The majority of new infections are due to sexual intercourse or shared needles/syringes. HIV can be transmitted through accidental needle sticks or exposure to infectious materials or any fluid with visible blood. There is no evidence that HIV can be spread through normal day to day contact or through infected food or water.[8,9]

Signs & Symptoms

Signs and symptoms of HIV will vary depending on the stage of infection and can vary from person to person. The early stages of HIV often present with either no symptoms or flu like symptoms and occur between 2-4 weeks after infection. As the infection progresses the individual may develop weight loss, fever,

diarrhea or coughs. Without treatment the individual may develop severe infections and cancers.[8,9]

Provider Safety

There is minimal risk of occupation exposure to paramedics from the HIV virus. Standard precautions are acceptable and no additional or special PPE are required. Even with exposure to bodily fluids, the risk from a direct contact infection to a non-mucous membrane is believed to be near zero. The largest risk is through needle-stick or other sharp object injuries, although this is estimated to be less than 1%.9,10 Paramedics should ensure proper sharps safety at all times with increased vigilance when caring for patients with the HIV infection. If an exposure is suspected the CDC recommends immediate treatment with antiviral therapies.[10]

Management

Treatment and management of a patient with HIV/AIDS is directed at treating opportunistic infections and cancer, managing their antiretroviral therapy and ensuring a healthy lifestyle. Patients are often on multiple medications to combat the virus in multiple ways. There can be many side effects associated with taking multiple medications daily such as nausea, vomiting, diarrhea, cardiac disease, bone loss, rhabdomyolysis, hyperlipidemia and hyperglycemia.[8,9] Paramedics should focus on symptom management as they arise.

Additionally, if working in a remote setting, paramedics should focus on preventative strategies. Education should focus on high risk groups and activities such as condom use during sexual intercourse, harm reduction for IV drug users, and promotion of HIV testing.

Cholera

Background & incidence

Cholera is a severe form of secretory diarrhea caused by the bacterium *Vibrio cholera* which can lead to severe dehydration. Originally found in the sub-Indian continents, cholera spread to Europe in the 1800s and today is endemic in a number of regions throughout the world.[11] The WHO estimates that there are between 1.3 and 4.0 million cases of cholera annually accounting for between 21,000 and 143,000 deaths.[12] Contracted through consumption of infected food and water, epidemics are often linked to natural disasters and humanitarian aid missions such as the 2010 earthquake Haiti, and the 2016-2017 Yemen outbreak.

Symptoms and signs

Symptoms can occur within a few hours up to five days post infection and during epidemics affects both children and adults equally. The majority of people affected will be asymptomatic or present with mild symptoms easily treated with oral rehydration. It is important to note that these individuals still shed the virus

in their stool for up to 10 days post infection. Only 5-10% of people that are infected develop severe disease.[11]

Cholera diarrhea, sometimes referred to as "rice water stools" (as it looks starchy like water that has been used to soak rice), is typically non-bloody and non-mucoid. This diarrhea can cause profound hypotension. Patients typically do not report pain and are afebrile but may also experience vomiting. As the diarrhea contains a number of important electrolytes, various metabolic disturbances are possible. Hypokalemia can cause weakness, cardiac arrhythmia and cramping. Hypocalcemia can cause muscle tetany and spasms. Hypoglycemia, more common in children, can occur rapidly and lead to CNS dysfunction including loss of consciousness and seizures. Loss of bicarbonate and hypoperfusion of tissue can lead to a metabolic acidosis. Left untreated, severe cholera can be fatal within a few hours.[11,12]

Secondary complications are typically related to dehydration and include stroke, renal tubular necrosis, and total circulatory collapse.

Management

For non-severe cholera patients should continue eating as usual and the focus should be on oral rehydration to replace fluids and electrolytes. IV rehydration is not typically recommended or necessary.[11] Tetracycline and erythromycin can help shorten the duration and severity of diarrhea, reduce the amount of rehydration required and shorten the period of time they shed the bacteria in their stool. Infants should be encouraged to continue breastfeeding. During an outbreak, immediate access to rehydration is required. Many people will be infected and have no symptoms, these people are still shedding the bacteria through their feces and can infect others for 1 -10 days after infection.

Prevention

As cholera is spread through fecal contaminated water, the best way to prevent spread is through proper hygiene and education. Short term solutions include promoting proper hand washing with soap, safe handling and storage of food and water, and the appropriate disposal of feces. Additionally individuals should be instructed to treat any water with an appropriate disinfectant (e.g. chlorine). Oral cholera vaccines have been shown effective with 60-85% prevention over 2-3 years.[14]

Long term solutions for cholera control include water treatment facilities (chlorination), household interventions such as safe water storage and water filtration or disinfection, and safe sewage disposal systems. These plans require long term maintenance and investments, many of which are unavailable for underdeveloped countries. The use of a decentralized sanitation system is possibly a more cost effective option for developing countries and is effective in cholera prevention.[11]



Provider Safety

When working in an area during a cholera outbreak or with endemic cholera, paramedics need to be vigilant to avoid contact with contaminated water or food. It is recommended to only drink bottled or boiled water and avoid using ice cubes.[12] Paramedics should practice good hand and personal hygiene with frequent hand washing with soap and use of hand sanitizer.[11] If it cannot be confirmed that safe water is available for cooking try to eat packaged foods when possible. Standard contact precaution PPE is effective in protecting providers from a cholera outbreak. Paramedics should don a gown, gloves, mask, and face shield to avoid contact with bodily fluids.[11,12]

Yellow Fever

Background & incidence

Yellow fever is a flavivirus that is transmitted by several different mosquito species with humans and other non-human primates as the primary hosts. Yellow fever is endemic in the tropical areas of Africa and South and Central America but can create large outbreaks if introduced into the urban environment.[15] Due to the non-specific nature of symptoms and the variety of clinical severity accurate epidemiological data is difficult to obtain.[15] Estimates from the early 1990's reported approximately

200,000 cases per annum and over 30,000 fatalities as a result.[15]

Prevention

Prevention is the best form of control for yellow fever. As yellow fever is only spread through mosquito bites, prevention of these bites is essential. The use of insect repellants (such as those containing DEET), wearing clothing which reduces exposure to bites, permethrin spray can be used on clothing to prevent bites, and using mosquito nets while sleeping. Immunization should be performed for anyone over 9 months who will be living or working in an area with a risk for yellow fever.[17,18]

Signs & symptoms

Yellow fever has a 3-6 day incubation period. After this time the majority of people do not develop any symptoms but remain potential hosts for the virus. Those who do develop symptoms typically report fever, chills, headache, widespread myalgia, and conjunctival congestion.[17] After several days, the majority of patients recover with no long term consequences. A small number of patients may develop a life-threatening illness with increasing fever, jaundice, renal failure and profuse bleeding (due to thrombocytopenia and coagulopathy). Bleeding can occur from the mouth, nose, eyes, or stomach.[17] Patients can often develop bleeding in the feces or vomit. Half of the patients who develop these severe symptoms will die within 10-14 days, those

who recover typically have no long term organ damage.[17,18,1]

Management

There is no specific treatment for yellow fever and providers should focus on symptom management.[18] Management of pyrexia, hypotension, pain and temperature are key priorities in supportive treatment of patients with yellow fever. Patients should also be kept indoors, ideally under a bug net canopy, to prevent further mosquito bites for the first few days of the patient's illness.[17,18] NSAIDs and ASA should be avoided as they increase the risk of bleeding.

Provider Safety

There are no additional PPE requirements when working with a patient with yellow fever and standard precautions are acceptable. Care should be taken to follow standard prevention steps for mosquito borne illnesses when working in areas with endemic yellow fever virus.

Tetanus

Background & Incidence

Tetanus is an infection caused by the spores of the bacterium *Clostridium tetani* which enters the body through open skin and affects the nervous system of subjects infected and can be fatal. The bacteria is found naturally in the soil and affects individuals of all ages. The bacteria

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produces a toxin called tetanospasmin which effects motor neurons. Tetanus is classified into 4 categories: generalized, localized, cephalic and neonatal tetanus. The last time data was collected for the United States there was an estimated 28 cases of tetanus per year.[19]

Prevention

Tetanus is preventable through vaccination and is typically given on a schedule as part of a combination vaccine with Diphtheria, Tetanus, and Pertussis. Doses are given on schedule up to the age of 12 years after which a booster is recommended every 10 years. Proper hand hygiene and cleaning of wounds is important for prevention of tetanus.[19]

Signs and Symptoms

From exposure to illness, Tetanus usually takes between 3 and 21 days, average of 8 days. [19] The closer to the central nervous system the shorter the incubation period and worse prognosis. As discussed previously there are four main manifestations of tetanus[19]:

- Local Tetanus:
 - A rare form of tetanus that only affects the area where the injury occurred. Patients experience persistent muscle contractions which can last for months. Local tetanus is rarely fatal
- Generalized Tetanus:
 - The most common form of tetanus. The first sign is typically lock jaw, nuchal rigidity, dysphagia and facial muscle involvement. As the disease progresses patients can have generalized muscle spasms in response to stimuli such as noise or light, these can be extremely painful and appear as tonic contractions with hyperextended back, extended extremities and clenched fists
- Cephalic Tetanus:
 - A rare form of tetanus that is associated with head trauma or otitis media, it can be localized or generalized
- Neonatal Tetanus:
 - Rare in North America but is a very common cause of death of infants in underdeveloped countries. It can occur due to an unsanitary delivery, cutting of the umbilical cord with contaminated instruments and lack of maternal immunization. An estimated 49,000 neonates died from tetanus in 2013 which is significantly lower than the 180,000 in 2002 but it is still a large concern in underdeveloped countries. In the United States, there are reportedly only 30 cases a year. Symptoms are similar to those of generalized tetanus

Complications of tetanus include laryngospasm or spasm of respiratory muscles which can cause respiratory distress or respiratory arrest. Additionally, sustained contractions or convulsions can cause fractures of the spinal

column or long bones. Hyper-reactivity of the autonomic nervous system can lead to dysrhythmias and hypertension.[19]

Management

All wounds should be cleaned and any necrotic tissue should be removed. If the patient is showing signs of tetanic spasms special attention should be paid to maintaining the patient's airway. Treatment with human tetanus immunoglobulin (TIG) is recommended for both children and adults. TIG works to remove any tetanus toxin that is unbound to nerve endings. Seizure control and control of muscle spasms through medications such as benzodiazepines are indicated. Magnesium sulfate and beta blockers are sometimes used to help control involuntary muscle spasms as well as heart rate and respirations.[19]

Provider Safety

Tetanus is not transmitted from person-to-person and therefore there is not an increased risk when working with patients with tetanus. [19] Vaccination and proper hygiene remain essential for prevention of tetanus. **CP**

Resources

WHO Tropical Diseases: http://www.who.int/topics/tropical_diseases/en/

CDC: <https://wwwnc.cdc.gov/travel/>

Specialist education in the area of tropical medicine exists for paramedics through courses such as the Tropical, Travel and Expedition Medical Skills course offered by the College of Remote and Offshore Medicine, and the Remote Advanced Medic Program offered by the Institute for Health Professionals at Portland Community College. In addition, there are several free online education courses available that address topics in this area of practice.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of their employers or organisations.

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AUTHORS



Dayna Hilliard is a Primary Care Paramedic in Ontario, Canada.

Email: daynahilliard@gmail.com

Twitter: @Dayna37



William Johnston is a Primary Care Paramedic and a faculty member in the Paramedic Programs at Fanshawe College in Ontario, Canada.

Email: johnstcw@gmail.com

Twitter: @seewillyj



Alan Batt is a faculty member in the Paramedic Programs at Fanshawe College in Ontario, Canada.

Email: abatt@fanshawec.ca

Twitter: @alan_batt