Tuberculosis

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Abstract

Tuberculosis is one of the world’s oldest infectious diseases. It is a disease that continues to affect millions of individuals worldwide. A brief history related to the course of this disease has been outlined. Through review of evidence based literature, a description of tuberculosis has been discussed. Clinical presentation, transmission, and treatment options have been identified. High risk populations, barriers to treatment, and other factors found to promote the prevalence of this disease are noted. Goals and interventions implemented by the World Health Organization have been discussed.
An Old Nemesis

Tuberculosis (TB) is an infectious disease that has plagued man-kind for centuries. Evidence of tuberculin infection has been found in spinal column fragments of ancient Egyptian mummies dating back as far as 2400 BC (New Jersey Medical School Global Institute of Tuberculosis, n.d.). The Greek philosopher Hippocrates, who termed the disease “phthisis”, meaning consumption, described the disease as nearly always fatal and further warned his colleagues against visiting late stage TB patients as their “inevitable death may damage their reputation as an attending physician” (New Jersey Medical School Global Institute of Tuberculosis, n.d.). Strange and futile attempts to cure the disease were made by Roman physicians that included: bathing in human urine, eating wolf livers, and drinking elephant blood (National Institute of Allergy and Infectious Disease [NIAID], 2006). Needless to say, these “cures” were ineffective and may have actually encouraged the disease process due to their unsanitary nature. It was not until the seventeenth century, that accurate pathological and anatomical descriptions of this disease emerged. Through the publication of his *Opera Medica of 1679*, Sylvius was able to accurately identify and describe the tubercles associated with TB as a consistent characteristic and furthermore, described their progression to abscesses and cavities in the bodies of TB patients (New Jersey Medical School Global Institute of Tuberculosis, n.d.). In 1720, the communicable nature of TB began to emerge as English physician Benjamin Marten conjectured, “that wonderful minute living creatures could be spread by habitual lying in the same bed with a consumptive patient, consistent eating or drinking with him, or by frequently conversing so nearly as to draw in part of the breath he emits from his lungs, a consumption may be caught by a sound person” (New Jersey Medical School Global Institute of Tuberculosis, n.d.). While an increasingly amount of information regarding the etiological nature of TB was
unfolding, cure and treatment options were still “a shot in the dark”. An initial step in the fight against TB began in 1849 with what has become known as “the sanatorium cure” (New Jersey Medical School Global Institute of Tuberculosis, n.d.). During this time, Doctor Hermann Brehmer was taken ill with Tuberculosis and following the orders from his doctor; he retreated to the Himalayan Mountains in search of a “better climate”. He returned cured and convinced that life at a higher elevation, with continuous fresh air, and good nutrition could cure anyone infected with this disease. He eventually built one of the first sanatoriums in Gorbersdorf, where his patients were isolated and subjected to copious amounts of food and fresh air (NIAID, 2006). Whether the fresh air and sanatorium practices were effective in curing TB is debatable, however, what the sanatoriums did accomplish is the isolation of sick infected patients from the general population. The greatest breakthrough discovery in the study of tuberculosis came on March 24th 1882. Microbiologist Robert Koch had utilized a new dual staining technique that allowed him to isolate the microbe responsible for TB, *Mycobacterium tuberculosis* (NIAID, 2006).

**Causes**

Tuberculosis is “an infectious disease process caused by *Mycobacterium tuberculosis* (Mtb) that typically manifests as a respiratory infection; however, it can also attack the kidneys, spine, brain, and skin” (Veenema, 2007, p. 449). Mtb is an aerobic bacterium, meaning that it requires oxygen to live, hence it is typically found in the upper air sacs of the lungs in active TB patients (NIAID, 2007). There are two different stages of tuberculosis; latent tuberculosis infection (LTBI) and active tuberculosis disease. A latent TB infection occurs when an individual has been exposed to an active TB patient and has inhaled enough of the Mtb microbes to cause infection. These microbes are unable to grow within an individual with a healthy immune
system, and thereby lay dormant, in many cases for years, unless treated (Centers for Disease Control and Prevention [CDC], 2009). When a healthy person becomes infected with Mtb, within two to six weeks, their immune system will respond by isolating and “walling off” infected cells. This reaction allows the body to maintain a “standoff” against the infection, and in some cases, allow complete recovery (NIAID, 2007). TB bacteria may become active when a person’s immune system becomes compromised and can no longer inhibit the bacteria from growing (CDC, 2009).

**Symptoms**

**Latent Tuberculosis.**

Individuals infected with latent TB do not feel sick, have any signs and symptoms of illness, or transmit the disease to anyone else (CDC, 2009). In fact the only indicator that a person has LTBI is a positive skin or blood test. Once diagnosed, LTBI does require treatment; as the infection can become active causing severe illness. Mtb cannot be transmitted from a person with an LTBI.

**Active Tuberculosis Disease.**

As previously mentioned, when an individual infected with Mtb is immune-compromised at the time of exposure, or becomes immune-compromised the Mtb bacterium become active and begins to grow. These individuals will feel sick and present with symptoms including; night sweats, fever, chills, a persistent cough that may produce bloody sputum, weight loss, chest pain, loss of appetite, and general feeling of malaise and fatigue (CDC, 2009).
Transmission

The microbes that cause a TB infection are transmitted through tiny microscopic droplets released into the air when an individual with active TB coughs, sneezes, laughs, speaks, or sings (NIAID, 2007). “TB is not transmitted by shaking someone’s hand, sharing food or beverages, kissing, or toilet seats” (CDC, 2009, para. 2). TB cannot be transmitted by those with infected LTB (CDC, 2009).

Diagnosis

There are two different initial tests used to diagnose TB: the TB Skin Test (TST), and special blood tests known as interferon-gamma release assays (IGRAs). (CDC, 2009) The Mantoux test is the most common test used to detect TB. The Mantoux test is performed by giving a sub-dermal injection of a small amount of tuberculin purified protein derivative (PPD) creating a “wheal” on the inner surface of the individuals’ arm (CDC, 2009). The individual should then return to their health care provider between forty-eight and seventy-two hours later to have their test read. Swelling at the injection site, indicating a reaction to the injected material, or a hard, raised, red bump (induration) is indicative of TB infection. The amount of induration determines whether the test results are significant, based on your risk factors for TB (MayoClinic, 2009). An induration of five millimeters or more is considered positive if the individual has HIV, had recent contact with a person with TB disease, has fibrotic changes on chest X-ray consistent with prior TB disease, a history of an organ transplant, or may be immune-suppressed for other reasons. (CDC, 2009). An induration of ten millimeters or more is considered positive in individuals: who are recent immigrants from high-prevalence countries, injection drug users, health-care providers, residents and employees of in high risk settings,
laboratory personnel, persons with clinical conditions that place them at high risk, children less than four years of age, and infants, children, and adolescents exposed to adults in high-risk categories (CDC, 2009). Bacille Calmette-Guérin (BCG) is a vaccine for TB disease. While uncommon in the United States, the BCG vaccination is widely used in other, high TB prevalence, countries. Individuals that have been vaccinated may have a false-positive reaction to the skin test. The special blood tests, IGRA’s, unlike the TST, are not affected by prior BCG vaccination and are less likely to give a false-positive result (CDC, 2009). The skin and blood test are simply initial indicators for TB exposure. When initial test results are positive, further testing that including a chest x-ray and acid-fast bacilli (AFB) sputum cultures is required to confirm a TB diagnosis. High-risk populations that should be tested regularly include: health-care providers, individuals that have spent time with a person known, or suspected, to have active TB disease, have HIV infection or another condition that weakens the immune system, have symptoms of active TB disease, immigrants from a country where active TB disease is common (Latin America, the Caribbean, Africa, Asia, Eastern Europe, and Russia), inmates, homeless, IV drug abusers, and nursing home residents (CDC, 2009).

**Treatment**

The course of treatment depends on the type of tuberculosis; LTBI or active TB disease. Treatment of TB, regardless of which type, requires a strict adherence to antibiotic medications for a much longer term than most bacterial infections. The exact treatment regimen depends on: age, overall health, possible drug resistance, the form of TB, latent or active, and the location of infection in the body (MayoClinic, 2009).
Latent TB.

Treatment of an LTBI is much simpler than active TB due to the fact that there are less of the Mtb bacteria to kill. The preferred course of treatment for LTBI is a drug called Isoniazid (INH) taken for nine months, though Rifampin is also used (CDC, 2009). Treatment regimens are customized to each individual based on factors such as lifestyle and medical history. During treatment with either drug, one should avoid using acetaminophen products and avoid alcohol use, as these could exacerbate the risk of liver damage.

Active TB.

The CDC identifies two objectives when treating active TB: cure the individual infected with the disease and minimize transmission to others (2009). There are four first-line core medications that are used, in combination, for the treatment of active TB: isoniazid (INH), rifampin (RIF), ethambutol (EMB), and pyrazinamide (PZA) (CDC, 2009). Treatment of active TB has two phases: an initial phase and a continuation phase. The initial phase of treatment lasts approximately two months, while the continuation phase can last between four to six months (CDC, 2009). Completion of treatment is determined by the number of doses of prescribed medications over a given amount of time (CDC, 2009). The CDC’s preferred regimen of treatment consists of: “daily doses of INH, RIF, PZA, and EMB for 56 doses for the initial phase and Daily INH and RIF for 126 doses or twice-weekly INH and RIF for 36 doses in the continuation phase” (CDC, 2009, para.2). Modifications to the preferred regimen of treatment may be made in special cases such as pregnant women, children, and individuals with HIV or liver disease (CDC, 2009).
In either case, whether treatment is being given to an individual with active TB disease, or a LTBI, adherence to the prescribed regimen is essential. Directly observed therapy (DOT) is a strategy that was developed to increase adherence to TB treatment regimens (CDC, 2009). “DOT is when a health-care personnel or another designated individual directly observes the TB patient swallow each dose of prescribed anti-TB medication” (CDC, 2009, para.3).

**Drug-Resistant TB**

In addition to many bacteria that cause many infectious diseases, TB bacteria can become resistant to treatment medications. This can occur for several reasons: individuals receiving TB treatment do not complete their prescribed regimen, health-care providers prescribe the wrong course of treatment, and drugs needed for treatment are inaccessible, or of poor quality (CDC, 2009). There are two types of drug-resistant TB: multi-drug resistant TB (MDR-TB) and extensively drug-resistant TB (XDR-TB) (CDC, 2009). MDR TB is a strain of TB that is resistant to two of the first line anti-TB drugs, isoniazid and rifampicin (CDC, 2009). XDR TB is a rare type of MDR TB that is not only resistant to isoniazid and rifampin, but also resistant to any fluoroquinolone and at least one of three injectable second-line drugs: amikacin, kanamycin, or capreomycin (CDC, 2009).

**Challenges**

The HIV epidemic and poor infrastructure of health systems in developing countries where TB is most common are two major challenges that face health-care organizations struggling to eradicate TB (Campbell, 2008). “TB is the leading killer among HIV-infected people. In fact, about 200,000 people living with HIV/AIDS die every year from TB” (Campbell, 2008, p26). Developing countries, where TB is prevalent, have resource-poor infrastructures that
have limited access to diagnostic and treatment options, as well as, poorly trained and unqualified personnel to manage TB (Campbell, 2008).

A Plan to Stop TB

The World Health Organization (WHO) launched their “Stop TB” strategy in 2006. Their vision is simple, to create a world free of TB (WHO, 2010 para.1). The components of their “Stop TB” strategy include: “Pursuit of high-quality DOTS expansion and enhancement, address TB-HIV, MDR-TB, and the needs of poor and vulnerable populations, contribute to health system strengthening based on primary health care, engage all care providers, empower people with TB, and communities through partnership, and enable and promote research” (WHO, 2010). Further details regarding their plan to stop TB are available on their website at www.who.int.

Conclusion

TB is a disease that has plagued humanity for centuries and continues to affect millions of individuals worldwide. Its airborne method of transmission is simple and effective. Many challenges to treating this disease face today’s health-care providers including: the type of TB, co-morbidities, such as HIV, age, and access to health-care. Effective testing, availability and adherence to treatment regimens are essential to eradicating this disease. The WHO has recognized TB as an international health crisis, identified potential barriers, and has implemented a plan of action.
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