

## Tuberculosis Explained

Tuberculosis (TB) is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or *Mycobacterium tuberculosis*. Although TB can be treated, cured, and can be prevented if persons at risk take certain drugs, scientists have never come close to wiping it out. Few diseases have caused so much distressing illness for centuries and claimed so many lives.

Tuberculosis was popularly known as consumption for a long time. Scientists know it as an infection caused by *M. tuberculosis*. In 1882, the microbiologist Robert Koch discovered the tubercle bacillus, at a time when one of every seven deaths in Europe was caused by TB. Because antibiotics were unknown, the only means of controlling the spread of infection was to isolate patients in private sanatoria or hospitals limited to patients with TB—a practice that continues to this day in many countries.

The net effect of this pattern of treatment was to separate the study of tuberculosis from mainstream medicine. Entire organizations were set up to study not only the disease as it affected individual patients, but its impact on the society as a whole.

When streptomycin, the first antibiotic effective against *M. tuberculosis*, was discovered in the early 1940s, the infection began to come under control. Other more effective anti-tuberculosis drugs were developed in the following decades. An additional factor is the AIDS epidemic. AIDS patients are much more likely to develop tuberculosis because of their weakened immune systems. There still are an estimated 8-10 million new cases of TB each year worldwide, causing roughly 3 million deaths.

### *High-risk populations*

Tuberculosis is more common in elderly persons. There are additional reasons for the vulnerability of older people: those living in

nursing homes and similar facilities are in close contact with others who may be infected. The aging process itself may weaken the body's immune system, which is then less able to ward off the tubercle bacillus. Finally, bacteria that have lain dormant for some time in elderly persons may be reactivated and cause illness.

TB also is more common in blacks, who are more likely to live under conditions that promote infection. At the beginning of the new millennium, two-thirds of all cases of TB in the United States affect African Americans, Hispanics, Asians, and persons from the Pacific Islands. Another one-fourth of cases affect persons born outside the United States. As of 2002, the risk of TB is still increasing in all these groups.

As of late 2002, TB is a major health problem in certain specific immigrant communities, such as the Vietnamese in southern California. One team of public health experts in North Carolina maintains that treatment for tuberculosis is the most pressing health care need of recent immigrants to the United States. In some cases, the vulnerability of immigrants to tuberculosis is increased by occupational exposure, as a recent outbreak of TB among Mexican poultry farm workers in Delaware indicates. Other public health experts are recommending tuberculosis screening at the primary care level of all new immigrants and refugees.

### *Lifestyle factors*

The high risk of TB in AIDS patients extends to those infected by human immunodeficiency virus (HIV) who has not yet developed clinical signs of AIDS. Alcoholics and intravenous drug abusers are also at increased risk of contracting tuberculosis.

Until the economic and social factors that influence the spread of tubercular infection are remedied, there is no real possibility of completely eliminating the disease.

## *Causes and symptoms*

### *Transmission*

Tuberculosis spreads by droplet infection. This type of transmission means that when TB patient exhales, coughs, or sneezes, tiny droplets of fluid containing tubercle bacilli are released into the air. This mist, or aerosol as it is often called, can be taken into the nasal passages and lungs of a susceptible person nearby.

Tuberculosis is not, however, highly contagious compared to some other infectious diseases. Only about one in three close contacts of a TB patient, and fewer than 15% of more remote contacts, are likely to become infected. As a rule, close, frequent, or prolonged contact is needed to spread the disease. Of course, if a severely infected patient emits huge numbers of bacilli, the chance of transmitting infection is much greater. Unlike many other infections, TB is not passed on by contact with a patient's clothing, bed linens, or dishes and cooking utensils. The most important exception is pregnancy. The fetus of an infected mother may contract TB by inhaling or swallowing the bacilli in the amniotic fluid.

### *Progression*

Once inhaled, tubercle bacilli may reach the small breathing sacs in the lungs (the alveoli), where they are taken up by cells called macrophages. The bacilli multiply within these cells and then spread through the lymph vessels to nearby lymph nodes. Sometimes the bacilli move through blood vessels to distant organs. At this point they may either remain alive but inactive (quiescent), or they may cause active disease. Actual tissue damage is not caused directly by the tubercle bacillus, but by the reaction of the person's tissues to its presence. In a matter of weeks the host develops an immune response to the bacillus. Cells attack the bacilli, permit the initial damage to heal, and prevent future disease permanently.

Infection does not always mean disease; in fact, it usually does not. At least nine of ten patients who harbor *M. tuberculosis* do not develop symptoms or physical evidence of active disease, and their x-rays remain negative. They are not contagious; however, they do form a pool of infected patients who may get sick at a later date and then pass on TB to others. It is thought that more than 90% of cases of active tuberculosis come from this pool.

Whether or not a particular infected person will become ill is impossible to predict with certainty. An estimated 5% of infected persons get sick within 12-24 months of being infected. Another 5% heal initially but, after years or decades, develop active tuberculosis either in the lungs or elsewhere in the body. This form of the disease is called reactivation TB, or post-primary disease. On rare occasions a previously infected person gets sick again after a later exposure to the tubercle bacillus.

### *Pulmonary tuberculosis*

Pulmonary tuberculosis is TB that affects the lungs. Its initial symptoms are easily confused with those of other diseases. An infected person may at first feel vaguely unwell or develop a cough blamed on smoking or a cold. A small amount of greenish or yellow sputum may be coughed up when the person gets up in the morning. In time, more sputum is produced that is streaked with blood. Persons with pulmonary TB do not run a high fever, but they often have a low-grade one. They may wake up in the night drenched with cold sweat when the fever breaks. The patient often loses interest in food and may lose weight. Chest pain is sometimes present. If the infection allows air to escape from the lungs into the chest cavity (pneumothorax) or if fluid collects in the pleural space (pleural effusion), the patient may have difficulty breathing. If a young adult develops a pleural effusion, the chance of tubercular infection being the cause is very high. The TB bacilli may travel from the lungs to lymph nodes in the sides and back of the neck. Infection in these areas can break through the skin and discharge pus. Before the

development of effective antibiotics, many patients became chronically ill with increasingly severe lung symptoms. They lost a great deal of weight and developed a wasted appearance. This outcome is uncommon today—at least where modern treatment methods are available.

### *Extrapulmonary tuberculosis*

Although the lungs are the major site of damage caused by tuberculosis, many other organs and tissues in the body may be affected. The usual progression is for the disease to spread from the lungs to locations outside the lungs (extrapulmonary sites). In some cases, however, the first sign of disease appears outside the lungs. The many tissues or organs that tuberculosis may affect include:

- **Bones.** TB is particularly likely to attack the spine and the ends of the long bones. Children are especially prone to spinal tuberculosis. If not treated, the spinal segments (vertebrae) may collapse and cause paralysis in one or both legs.
- **Kidneys.** Along with the bones, the kidneys are probably the commonest site of extrapulmonary TB. There may, however, be few symptoms even though part of a kidney is destroyed. TB may spread to the bladder. In men, it may spread to the prostate gland and nearby structures.
- **Female reproductive organs.** The ovaries in women may be infected; TB can spread from them to the peritoneum, which is the membrane lining the abdominal cavity.
- **Abdominal cavity.** Tuberculous peritonitis may cause pain ranging from the vague discomfort of stomach cramps to intense pain that may mimic the symptoms of appendicitis.
- **Joints.** Tubercular infection of joints causes a form of arthritis that most often affects the hips and knees. The wrist, hand, and elbow joints also may become painful and inflamed.

- **Meninges.** The meninges are tissues that cover the brain and the spinal cord. Infection of the meninges by the TB bacillus causes tuberculous meningitis, a condition that is most common in young children but is especially dangerous in the elderly. Patients develop headaches, become drowsy, and eventually comatose. Permanent brain damage is the rule unless prompt treatment is given. Some patients with tuberculous meningitis develop a tumor-like brain mass called a tuberculoma that can cause stroke-like symptoms.
- **Skin, intestines, adrenal glands, and blood vessels.** All these parts of the body can be infected by *M. tuberculosis*.
- **Infection of the wall of the body's main artery (the aorta),** can cause it to rupture with catastrophic results.
- **Tuberculous pericarditis** occurs when the membrane surrounding the heart (the pericardium) is infected and fills up with fluid that interferes with the heart's ability to pump blood.
- **Miliary tuberculosis.** Miliary TB is a life-threatening condition that occurs when large numbers of tubercle bacilli spread throughout the body. Huge numbers of tiny tubercular lesions develop that cause marked weakness and weight loss, severe anemia, and gradual wasting of the body.

### *Diseases similar to tuberculosis*

There are many forms of mycobacteria other than *M. tuberculosis*, the tubercle bacillus. Some cause infections that may closely resemble tuberculosis, but they usually do so only when an infected person's immune system is defective. People who are HIV-positive are a prime example. The most common mycobacteria that infect AIDS patients are a group known as *Mycobacterium avium* complex (MAC). People infected by MAC are not contagious, but they may develop a serious lung infection that is highly resistant to antibiotics. MAC infections typically start with the patient coughing up mucus. The infection progresses slowly, but eventually blood is brought up and the patient has trouble breathing. In AIDS patients, MAC disease can

spread throughout the body, with anemia, diarrhea, and stomach pain as common features. Often these patients die unless their immune system can be strengthened. Other mycobacteria grow in swimming pools and may cause skin infection. Some of them infect wounds and artificial body parts such as a breast implant or mechanical heart valve.