TUBERCULOSIS (TB) IS still one of the world’s most infectious killers – in 2013, it was responsible for the deaths of 1.5 million people. This chronic infectious disease is of particular concern within developing countries; around 95 per cent of TB-associated deaths occur in low- and middle-income nations, and the greatest number of new cases per capita appear in Africa. Furthermore, TB is the leading killer of people living with HIV and, in sub-Saharan Africa, at least a third of people with HIV are coinfected.

Five criteria have been established as causative agents for the emergence and re-emergence of infectious diseases such as TB: cross-species transfer, spatial diffusion, pathogenic evolution, new characterisations of pathogens and alterations in human-environment relationships. The changing clinical presentation of TB in South Africa is most likely due to the evolution of the disease, and in particular, changes in strain lineages and host genetics.

MULTIDRUG RESISTANCE

In 2013, 480,000 people developed multidrug-resistant TB (MDR-TB), which was first reported in 1985 and is resistant to rifampicin and isoniazid, the two most effective first-line treatments. Moreover, in 2006, the first cases of extensively drug-resistant TB – a form of MDR-TB with a stronger resistance – were reported in KwaZulu-Natal in South Africa.

With TB and its increasing drug resistance continuing to present a significant health issue, Professor Maryna Steyn and her colleagues from the Forensic Anthropology Research Centre at the University of Pretoria, South Africa, are investigating how the disease has evolved over time. “Since 1985, two significant developments have occurred – coinfection with HIV became very common and drug resistance emerged,” Steyn explains. “I was curious to see if these would have any influence on skeletal TB, and if the expression of the disease changed at all from the pre-1985 cases.”

SKELETAL INSIGHTS

Palaeopathology is the study of disease evolution, and is usually conducted through the analysis of skeletons. Presentations of past diseases can be explored to ascertain how a
Have you noticed any major differences when comparing cases of bone lesions associated with TB in the pre- and post-antibiotic periods?

Yes, not only in the frequency of bone involvement, but also in the pattern. Today, more people have bone lesions; some of these are mild – such as plaques on the visceral surface of ribs or mild periostitis – but in other cases they are very severe.

We are in the process of conducting a follow-up study in the Western Cape and have been surprised at the many individuals with cranial involvement, for example. Vertebral lesions, which are the classic lesions by which TB was diagnosed in the past, are seemingly becoming less common, but can be very debilitating when they occur.

What are the challenges involved in the exhumation and forensic analysis of human remains?

It can be very difficult to specifically diagnose conditions in the skeleton. Bone can only react in two ways: through depositioning (osteoblastic response) or removal (osteoclastic response) – or a combination of the two. Therefore, lesions can be very non-specific, and that is why we opted to create a ‘non-specific’ group for cases that could not be characterised with precision.

For each case, the research team came to a consensus as to whether or not the individual should fall into the TB group. We also took photographs to be reviewed in detail afterwards to ensure we were consistent and enable us to refer back to every case. For the background information on each individual, we were dependent on the records of the skeletal collections and had to go by what was recorded for each specific individual (including age, sex, ancestry and cause of death).

Can you outline your project’s greatest and most surprising accomplishments?

I was surprised at the clear picture that emerged from the data showing an increasing involvement of the skeleton, which I did not foresee beforehand, and at the feedback and interest we are getting on our study. Moreover, it has been particularly pleasing that we, as osteologists, can contribute to the understanding of the disease.

A previous palaeopathologic study on TB by Holloway et al. in 2011 found that: firstly, there was a reduction in the frequency of bone lesions in the modern – yet pre-antibiotic – period; and secondly, in this same period, lesions were more commonly observed on the ribs rather than the spine, where they were predominant in the past.

With this research in mind, Steyn’s team decided to further investigate whether the frequency of bone lesions and patterns of skeletal involvement had changed since the introduction of antibiotics.

LIVING LONGER

Steyn and her colleagues studied the skeletons of 147 individuals from the Cauteng province in South Africa who had died from TB. These cases were split into three groups: those dying before 1950 (presumed not to have received antibiotics), those dying between 1950 and 1985 (considered to have been treated with antibiotics), and those dying after 1985 (when coinfection with HIV and resistance to anti-TB drugs surfaced).

In total, a third of the individuals analysed had bone lesions that could be linked to TB; 21.1 per cent, 38.2 per cent and 41.0 per cent in the three groups, respectively. With this notable increase, Steyn’s research suggests that people who die from TB in the present day are increasingly likely to have bone lesions, and that these are appearing more often in the ribs and less often in the spine.

From these results, the team proposed that while antibiotic treatment enables people to survive longer with TB, it in turn allows more time for bone lesions to develop. “In essence, we are making people live longer but they suffer more,” Steyn elaborates.

KEEPING PACE

To gather more evidence, the group has since expanded its study to a further 58 skeletons from the Western Cape and found an even higher number of individuals who died after 1985 as a result of cranial involvement. It was identified that five skeletons had lesions within the cranial fossa, one had lesions on the exterior of the skull, and a further five had advanced temporomandibular destruction – most likely due to TB.

This research is crucial for understanding how the disease is continuously evolving and the implications this has on its treatment: “TB is not stagnant or unchangeable, and it is a continuous struggle to stay ahead in this race,” Steyn argues. “What is desperately needed is for new drugs to be developed, especially to combat the increasing drug resistance.”

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