The opportunist mycobacteria—a 20-year retrospect

J. MARKS

Tuberculosis Reference Laboratory,
(Public Health Laboratory Service),
University Hospital of Wales, Cardiff

P. A. JENKINS

Summary
A review is presented of the incidence and distribution
of infections with opportunist mycobacteria in Wales
for the years 1952–71. The most important opportunist
pathogen was Mycobacterium kansasii.

Although the numbers affected by each species were
small, taken together they indicate a genuine increase
in incidence over the two decades. As tuberculosis
decayed by five-sixths over the same period, the
relative change has been striking.

The distribution of infections suggest that exposure
to dust at work and to heavy air pollution at home
pre-dispose to infection by opportunist mycobacteria.

The Tuberculosis Reference Laboratory is now in its
twentieth year of close involvement with the oppor-
tunist mycobacteria. This period followed, and was a
consequence of, the introduction of chemotherapy
for tuberculosis. The new problems of management
required a close study of the patient’s organism and
it then became clear that some infections, clinically
and pathologically indistinguishable from tubercu-
losis, were due to mycobacteria which were not
tubercle bacilli. They were first called ‘anonymous’
mycobacteria but as specific names have now been
applied to them, the alternative term of ‘opportunist’
mycobacteria is more appropriate. The Reference
Laboratory has been well-situated to investigate
these organisms, as it has access to all the relevant
material in Wales where the incidence of opportunist
infections is substantial. A few cases may have been
missed in the first year or two but the screening
procedures applied subsequently are thought to have
been completely effective.

Mycobacterium kansasii

The most important opportunist in Britain is
Mycobacterium kansasii. With few exceptions, the
infections caused simulate pulmonary tuberculosis,
mostly in middle-aged men. Identification of the
organism is not sufficient to establish the presence
of an infection; any of the opportunist mycobacteria
can appear in specimens by accident and supporting
evidence is necessary. However, most isolates of
M. kansasii in practice prove to be significant. In
Wales, kansasii infections are almost confined to
miners and people who live in large towns. The rural
incidence in England seems to be relatively low as
well. Figures 1 and 2 illustrate the contrast between
the distribution of tuberculosis and kansasii infec-
tion in Wales. The two infections differ also in their
trend because whereas the incidence of tuberculosis
in Britain is declining, kansasii infections in Wales
at least appear to be slowly increasing in number.

In Fig. 3 the cases recorded were all pulmonary
except for one of cervical adenitis and one joint
infection. Over the same period, tuberculosis declined
by about five-sixths so that the proportion of cases
which present clinically as tuberculosis but are in
fact kansasii infection has risen considerably. Overall,
the proportion is now 2% or so, but it can be very
much higher in urban areas, for example, in the city
of Cardiff it is ca. 5%. Figure 3 shows also the
incidence of patients with single isolates from
sputum. Some such cases are non-significant but
others represent inadequate follow-up and a few
may be examples of short-lived infection.

Figure 4 presents the incidence of M. kansasii in
Cardiff. The impression given is of a small epidemic
imposed on an endemic situation. Figure 5 shows the
location of the homes of these patients, excluding
men who work in dusty occupations, some of which
are believed to favour opportunistic infections. The
distribution can be seen to be concentrated near the
two main channels of communication. There are
large residential areas, both working- and middle-
class, at some distance from these routes, which have
not produced a single case. It appears therefore that
people may be predisposed to kansasii infection by
air pollution either at their work or, when they live
near heavy road or rail traffic, in their homes.

The natural habitat of M. kansasii has not yet
been demonstrated but it will almost certainly prove
to be water. We have never found photochromogens,
i.e. mycobacteria like M. kansasii, stimulated to
form pigment by light, except in water and two
workers have isolated the organism from piped water or taps. Presumably, infection is by means of aerosols generated in the use of water although ingestion followed by localization in the lung is a possibility.

Kansasii infection rarely spreads to contacts. No case of the infection by a patient of a child or spouse has been met in the present series but it does include a nurse and a small number of miners probably infected by contact. The miners had pneumoconiosis which appears to be responsible for increased susceptibility.

**Mycobacterium avium**

*M. avium* is widely distributed as a pathogen of wild and farm birds and not uncommon as an opportunist pathogen for cattle and pigs. Human infections are relatively infrequent and occur more in rural than in urban areas, as might be expected from the organism's normal habitat. Many cases are associated with pneumoconiosis which appears to be a particularly predisposing factor. This perhaps explains the somewhat higher than average incidence of avian infections in Wales, which has a high incidence of pneumoconiosis. Figure 6 records thirty-two cases of infection with *M. avium* of which nineteen were pulmonary and associated with pneumoconiosis. No particular trend or pattern is
Opportunist mycobacteria

There were seven other lung infections, one in a young Cardiff butcher and presumably occupational. The rest represent isolates from cervical adenitis, an abscess, a wrist ganglion, an appendix, pericardial fluid and two from endometrium. In the last four cases, the significance of finding *M. avium* is uncertain. These infections show little or no response to chemotherapy. Systemic infection is fatal and pulmonary cases have a bad prognosis, although deterioration may be slow. However, infections of lymph nodes and superficial tissues recover spontaneously or with the help of surgery.

*Mycobacterium intracellulare*

This organism has also been called the Battey bacillus after a Sanatorium where its role as a pathogen was established. The species differs from *M. avium* in minor biochemical properties and in that its members are not natural pathogens for birds;

![Fig. 5. Distribution of infections with Mycobacterium kansasii in Cardiff, excluding those subjects with a history of industrial dust exposure.](image)

![Fig. 6. Incidence of infections with Mycobacterium avium in Wales 1952–71.](image)

![Fig. 7. Incidence of infections with Mycobacterium intracellulare in Wales 1952–71. Closed circles, significant isolates; open circles, significance doubtful.](image)
nor are they usually virulent for fowls experimentally. The species appears to live normally in soil and is therefore ubiquitous. One consequence is that the special rural incidence of *M. avium* is absent and another is that the organism not infrequently appears in specimens as a contaminant. Special care is therefore needed in assessing the significance of an isolate. In some countries, the environment of certain areas is densely populated with *M. intracellulare* and in these the incidence is high both of clinical infection and non-significant isolates.

In general, *M. intracellulare* is much more frequent as an opportunist pathogen for man than *M. avium* is, but the reverse is true for animals. In Britain it most commonly causes cervical adenitis in children but in most other countries, lung infections in adults.

The incidence of intracellular infections in Wales more than doubled in the second decade of the present survey as compared with the first decade (Fig. 7). The number of cases was small but taking them together with our kansasii cases, which have also increased in number, there seems to have been a genuine increase in opportunistic infections. It is tempting to relate this increase to the decline of tuberculosis which must have left many people having a low immunity to mycobacteria open to opportunistic infection. However, in Western Australia where intracellular infection is exceptionally common, its incidence has not changed during the local recession of tuberculosis. So far as lung infections are concerned, the difference in trend may be due to the effect of air pollution in Wales.

*Mycobacterium scrofulaceum*

*M. scrofulaceum* is closely related to *M. intracellulare*. It appears to be less virulent on the whole, however, because although it causes cervical adenitis in children and occasionally superficial lesions, lung infections are very rare and limited to people subject to obvious predisposing conditions. Although we have only isolated this species once from natural soil, this seems its likely habitat. A pot of soil artificially inoculated retained a flourishing population of the organism when cultured more than 2 years later. Non-significant isolates are not unexpected therefore—there were six in our series compared with four significant. Contaminating strains are sometimes recovered from urine. Opportunistic mycobacteria of any kind in urine have not proved significant in our own experience but have been reported to be excreted in rare cases of systemic infection or epididymitis. Otherwise, isolates from urine should be dismissed except as a signal for cleaner collection of specimens.

*Mycobacterium xenopi*

*M. xenopi* has some resemblance to the three species last discussed but has a number of highly distinctive characters of its own. For example, it is the only opportunist mycobacterium to be clearly thermophilic. In Britain, it is found chiefly in London and on the South Coast but also presents in coastal and estuary areas which are not too far North. The distribution is shown in Fig. 8 which records the first 104 cases identified in the Reference Laboratory. Isolates are frequent on the opposite Channel coast but have so far been recognized only sporadically elsewhere in Europe.

In certain of our coastal towns, the environment appears to be heavily contaminated, resulting in a high incidence of non-significant isolates, but also some genuine infections. *M. xenopi* has been found in the water supply of a hospital—the hot system was more affected than the cold. But its true habitat is not known. Its distribution and preference for a high temperature suggest that *M. xenopi* may be a pathogen or commensal of sea-birds. Very recently we have begun to receive a few isolates from the Midlands and it may not be a co-incidence that sea-birds are said to have ventured further inland than usual in the last few years. However, we have no concrete evidence for the theory, as yet.

If the heavily infested areas are excluded, about half of the isolates of *M. xenopi* met are significant. In Wales, the proportion has been eight significant to six non-significant. All the cases found in Britain have been adults with lung infection. There has been no apparent relation to industry or air pollution, perhaps because of the special distribution of the
Opportunistic mycobacteria

The organism is sensitive to several drugs in vitro but its response in vivo is uncertain. Resection of lung has been useful in some cases.

*Mycobacterium fortuitum*

Rapidly-growing mycobacteria are isolated from sputum with unusual frequency in Wales. The best-known species is *M. fortuitum* but *M. peregrinum* is even more common and there are a number of other entities which lack names. They are mostly found in the sputum of miners, sometimes repeatedly over long periods. No obvious clinical illness can be attributed to the presence of these mycobacteria, so one must assume a carrier state, presumably due to an impairment of normal clearing mechanisms in men heavily exposed to coal dust. A study of Welsh miners has also shown that they develop allergy to opportunistic antigens with undue frequency and it is possible therefore that a form of long-term damage, perhaps even progressive massive fibrosis, could be initiated by opportunistic colonization. The special prevalence of the fast-growing mycobacteria in Welsh as opposed to English miners has not yet been explained because *M. fortuitum* at least is ubiquitous. It is possible that this phenomenon and the high local incidence of pneumoconiosis are both due to some special property of Welsh coal such as a high toxicity or a particular tendency to produce particles in the respirable range.

*Mycobacterium marinum*

The organism known as *M. marinum* and formerly as *M. balnei* is responsible for swimming-bath granuloma. Cardiff has the unfortunate distinction of having provided the only major outbreak in Britain of this infection. The organism is able to live freely in water or on surfaces bathed by water but is also well-known as a pathogen for fish, amphibia and reptiles. It is also now recognized as the occasional cause of skin lesions in people with home aquaria but in a few cases there is no history incriminating water. *M. marinum* is a psychrophile and therefore never causes internal disease. For the same reason, attempts to culture it will usually fail unless a temperature below 37°C is used.

The opportunist mycobacteria present a number of interesting problems, especially as regards their habitat and epidemiology. Whatever happens to tuberculosis they will always be with us and they are likely to assume more importance than they have at present. It is therefore advisable for us to learn more about these creatures in order to be well prepared.
The opportunist mycobacteria—a 20-year retrospect

J. Marks and P. A. Jenkins

Postgrad Med J 1971 47: 705-709
doi: 10.1136/pgmj.47.553.705

Updated information and services can be found at:
http://pmj.bmj.com/content/47/553/705

These include:

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/