Extrapulmonary tuberculosis: a potential source of laboratory-acquired infection

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SUMMARY A three-year retrospective study has demonstrated the effect of extrapulmonary tuberculosis on safety within a routine bacteriology laboratory. The investigation showed that, from 112 patients, 162 specimens considered to present a risk to laboratory staff were processed outside of the B1 protective area. However, it was estimated that only 51 of these specimens were heavily positive. Of these, 57% were sputum, 30% pus, and 10% urine. Specimens of pus and urine account for 50% of specimens received for non-tuberculous investigations, and it would be impossible to process all specimens that might present a risk in B1 accommodation and still maintain a high degree of safety. It is recommended that request forms which accompany specimens should clearly indicate potential high-risk specimens.

Surveys in Britain have shown that the risk of medical laboratory staff acquiring tuberculosis was three to five times greater than that of control groups of similar age and social status.^{1 2} These reports and other events were the prelude to codes of practice. The first, prepared by the Public Health Laboratory Service, dealt with safety in working with tuberculous material.³ The Howie code of practice for the prevention of infection in clinical laboratories was later published by the Department of Health and Social Security.⁴ It has been recommended that priority be given to the implementation of those measures directly relating to tuberculosis and hepatitis.⁵ The Howie code's most important recommendation is for the use of special accommodation when working with category B1 organisms, which includes the pathogenic mycobacteria. Within this accommodation all clinical material and cultures should be handled in category 1 microbiological safety cabinets designed to British Standard specification.⁶

Sputum is generally regarded as the clinical specimen most likely to contain tubercle bacilli and therefore to present the greatest hazard to laboratory staff.⁷ However, the clinical presentation of tuberculosis in this country has changed considerably in recent years. Extrapulmonary tuberculosis accounts

for approximately one-third of the national notifications and is even more common, amounting to over half of notifications in immigrants whose country of origin is in the Indian subcontinent.⁸ The British Thoracic and Tuberculosis Association survey of 1971 showed that more than 70% of new patients in Brent and Ealing were born outside the British Isles.⁹ The Hammersmith Hospital is situated in an area close to both of these boroughs and is therefore well placed for investigating the effect that extrapulmonary tuberculosis may have on laboratory safety.

A three-year retrospective study has been made covering the period January 1976 to December 1978. The main aim of this study was to analyse all clinical specimens that were culture positive for mycobacteria and to assess the frequency with which these or a similar specimen from the same patient were processed in the routine laboratory outside the category B1 accommodation.

Methods

CULTURE POSITIVE PATIENTS

During the period investigated, a total of 129 patients were found to have had one or more specimens culture positive for mycobacteria. Of these patients, 78 were admitted to the Hammersmith Hospital, 48 were attending the hospital as outpatients, and three were admitted to the Acton Hospital.

LABORATORY ORGANISATION

All laboratory work was carried out in the bacteriology department of the Royal Postgraduate Medical School. On arrival in the laboratory specimens accompanied by a request for examination for tuberculosis were transferred to a section dealing specifically with mycobacteria. In this section of the laboratory all techniques were performed in category 1 microbiological safety cabinets and in an area that conforms with the Howie recommendations for B1 accommodation. Specimens for investigations other than tuberculosis were examined in the routine laboratory on the open bench with the exception of sputum specimens which were processed in a category 1 cabinet housed within the routine laboratory.

BACTERIOLOGICAL RECORDS

A computer-assisted reporting and information system was in use during the entire period of the study.¹⁰ The system provides cumulative reports of bacteriological investigations, including those for tuberculosis. Using this system it was possible to recall the bacteriological records of all patients from whom at least one clinical specimen had yielded a culture positive for mycobacteria.

DEFINITION OF SPECIMENS

Specimens found to be culture positive for *Mycobacterium tuberculosis* were classified as 'parent

specimens'. The term 'risk specimen' was used for those which came from the same patient and clinical site as a parent specimen, were received within 10 days of the parent specimen, and were processed in the routine laboratory (outside the B1 accommodation).

Results

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A total of 483 culture positive specimens were received from 129 patients (Table 1). Of these, 408 cultures were identified as *M. tuberculosis*. They came from 112 patients, of whom 48 (43%) had pulmonary tuberculosis, 58 (52%) had extrapulmonary disease, and six (5%) presented with simultaneous pulmonary and extrapulmonary infection. *Mycobacterium kansasii* was repeatedly isolated from two patients and *Mycobacterium xenopi* from seven patients. Four patients with abscess formation after BCG vaccination yielded cultures with characteristics of BCG. The specimens from the remaining four patients yielded occasional isolates of mycobacterial species which occur more commonly as saprophytes than as pathogens. The 75 cultures other than *M. tuberculosis* were not considered to present an infection hazard, and parent specimens yielding these organisms, and their corresponding risk specimens, have therefore been omitted from the remainder of the results.

SPECIMEN TYPE AND DEGREE OF POSITIVITY

Table 2 sets out the type of parent and risk specimens received, and the number of heavily positive parent specimens, defined as those yielding more than 100 colonies on a slope of culture medium. The number of heavily positive risk specimens was estimated on the assumption that these specimens would occur in the same proportion of risk specimens as had occurred in the parent specimens. Sputum accounted for 67% of 408 parent specimens, pus for a further 13%, and urine for 8%. Among the 162 risk specimens, only

Table 1 *Mycobacteria*

Organism	Type or specimen	No. of patients	No. of isolates
<i>M. tuberculosis</i>	All specimens	112	408
<i>M. kansasii</i>	Sputum	2	21
<i>M. xenopi</i>	Sputum	7	43
<i>M. bovis</i> var BCG	Pus	4	6
<i>M. fortuitum</i>	Sputum	1	2
<i>M. flavescens</i>	Urine	1	1
<i>M. flavescens</i>	Endometrial biopsy	1	1
<i>M. gordonae</i>	Urine	1	1
	Total	129	483

Table 2 *Origin and degree of positivity of parent specimens and origin and estimated positivity of risk specimens*

Type of specimen	Parent specimens				Risk specimens			
	All		Yielding >100 colonies		All		Estimated >100 colonies	
	No.	%	No.	%	No.	%	No.	%
Sputum and gastric lavage	276	67	150	85	54	33	29.3	57
Pus	55	13	17	10	50	31	15.4	30
Urine	31	8	6	3	27	17	5.2	10
Lymph glands	15	4	3	1.5	6	4	1.2	2
Fluids	15	4	0	0	17	10	0	0
Tissue	14	3.5	1	0.5	5	3	0.4	1
C.S.F.	2	0.5	0	0	3	2	0	0
Total	408	100	177	100	162	100	51.5	100

33% were sputum while pus (31%), urine (17%), and other fluids (10%) were more often encountered. Of the 177 heavily positive parent strains, 85% were from sputum and 10% from pus, other specimen types rarely yielding more than 100 colonies. In contrast, only 57% of the estimated heavily positive risk specimens were sputum, while 30% were pus, and 10% urine.

SEQUENCE OF PARENT AND RISK SPECIMENS

Analysis of the dates of receipt of parent and risk specimens in the laboratory (Table 3) shows that the great majority of risk specimens were received before the parent strain could have been recognised as being positive for acid-fast bacilli by microscopy. Of the 162 risk specimens, 87% arrived before or on the same day as the parent specimen and a further 10% during the next five days. In the 20 instances in which specimens were received during the 10-day period after the parent specimens, 16 of the parent specimens were smear negative. Thus only four of the 162 risk specimens could have been recognised as a potential infection risk by examination of the parent specimen.

NOTIFICATION OF RISK ON REQUEST FORM

Of the request forms received with the 108 non-sputum risk specimens, 94% were still available, but only 37% were available from those received with the 54 specimens of sputum. A clinical diagnosis of possible tuberculosis was made on only 24% of the request forms for the 101 non-sputum specimens.

Discussion

At first sight it was surprising to find that 57% of culture-positive patients in this study had extra-pulmonary tuberculosis, but this finding was no doubt due to the large immigrant population served. Sputum was, however, the most frequent culture-positive specimen, multiple specimens being sent from each patient because of the ease with which it is obtained. As specimens other than sputum were found to be less heavily positive, it may be argued, they present less risk. It is also probable that some

specimens, because of their viscosity, for example, tissue and pus, are less likely to create an infective aerosol than specimens such as urine. However, the hazards produced in laboratories by infective droplet-nuclei are a direct result of the techniques used during the examination of specimens. For instance, homogenisation, centrifugation, and preparation of smears are all techniques known to produce aerosols.¹¹

If one considers the nature of the risk specimens, those specimens yielding more than 100 colonies are most likely to be an infection risk. Of these, 57% were sputum but 30% were pus and 10% urine. The Howie code recognises sputum as the most hazardous clinical specimen. However, it does not take account of other specimens. In our laboratory, specimens of pus and urine account for 50% of the bacteriological specimens received for routine (non-tuberculous) investigation. If we were to avoid exposure to all of the specimens that contain numerous tubercle bacilli, 50% (approximately 30 000) of the specimens would be processed in category 1 cabinets. It would be impossible to process all of these specimens in B1 accommodation and at the same time preserve the concept that this accommodation is a separate and special area designed specifically for high-risk work. Rather than process all specimens that might contain B1 pathogens in special accommodation it would be more efficient to be able to identify the small proportion of specimens, sent for routine examination, that are likely to contain these pathogens. This might be achieved if request forms were labelled in a manner easily recognisable by laboratory staff to indicate the infection risk. In this study, however, it was rare for request forms from these specimens to have any indication that they might present an infection risk and even rarer for the message to be comprehensible to clerical and technical staff.

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- 3 Precautions against tuberculous infection in the diagnostic laboratory. *Mon Bull Ministry of Health & PHLs* 1958; 17:10-8.
- 4 Department of Health and Social Security. Code of practice for the prevention of infection in clinical laboratories and post-mortem rooms. London: HMSO, 1978.

Table 3 Interval between receipt of parent and risk specimens

Receipt of risk specimen	Sputum	Non-sputum	Total	%
6-10 days before parent	2	4	6	4
1-5 days before parent	14	32	46	28
Same day as parent	34	56	90	55
1-5 days after parent	3	13	16	10
6-10 days after parent	1	3	4	3
Total	54	108	162	100

- ⁵ Department of Health and Social Security health circular. 1979;HC(79)3.
- ⁶ Specification for microbiological safety cabinets. British standard 5726:1979; London: British Standards Institution.
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