Nosocomial Infection of Tuberculosis

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Abstract: In the midst of increasing outbreaks of tuberculosis (TB) in recent years, the increase of TB infection within medical facilities has also been concerned. Among recent reported cases of TB outbreaks, 20% are related to medical facilities. One recent observation indicates that the TB case rate of female nurse is almost twice as high as that of the average female population. The main cause for this is that while the proportion of the health staff that have never been previously infected with TB is on the increase, the risk of developing the disease among the mid-aged or elderly patients that they contact with is still persistent. Other factors may include; the delay in diagnosing TB, the relative increase in TB patients with serious disease at onset, and the increase in medical procedures inducing coughing. In addition, it has to be pointed out that there has not been more attention paid to this problem in Japan. A research team of the Ministry of Health, Labor & Welfare has recently announced the guidelines for its prevention in 2001. We have much to learn from the experience of the US where attempts have been made to address this issue much earlier.

Key words: Tuberculosis; Nosocomial infection; Epidemiology; Prevention; Hospital

Increase of Nosocomial Infection

In the midst of the increasing outbreaks of small epidemics of TB in recent years, the increase of nosocomial TB infections, i.e. TB infection that takes place in medical facilities, has also been concerned. Figure 1 illustrates the main sites of TB outbreaks (defined as a case where 20 or more persons are infected from a single source of infection, development of a patient being counted as equivalent to 6 infections) out of 156 cases reported to the Ministry of Health, Labor and Welfare during 1998–2001. While many cases are observed in schools and business offices as have been in the past, “general hospitals” and “mental hospitals” are also among the common sites of TB outbreaks. Several examples from these are shown below.

1. Maternity hospitals: The source of infection was a 22 year-old pregnant woman who was sent to two hospitals (X and Y) succes-
A total of 13 people including inpatients in the same room and in the adjacent rooms, visitors, and hospital personnel were infected and developed disease. The source of infection had had coughing for a long time but it was not until after her childbirth at Y hospital that she was finally diagnosed as smear-positive TB. Two babies in the adjacent room that had no direct contact with her were also infected from her. They both developed miliary TB with meningitis, due to identical TB strains as proved by RFLP. The source patient was hospitalized in X hospital for 17 days and 5 days in Y hospital 2 months later, infecting 11 people at X hospital, and 2 at Y hospital.

2. Clinic with beds: A clinic with beds reported 3 new TB cases within a week, followed by another 2 new cases in the next 2 months (bacteriologically all smear positive). As a result of an investigation, it turned out that there had been another patient 2 months previously who was diagnosed as heavily smear positive and died shortly later. From RFLP analysis, the latter two patients were confirmed to have had strains of the same pattern.

3. Mental hospital: There were 18 cases of TB infection among inpatients at a mental hospital in 3 years. The RFLP patterns of the isolates from 4 patients from whom strains were obtainable were proved as identical. Although the infection of these patients were reported to the public health centers of the patients’ residence following the TB Control Law, since they had been in hospital, the public health center of the hospital’s district was not able to recognize the outbreak of TB at an early state.

4. ENT clinic: A private ENT clinic had among its patients 15 cases of TB otitis media and 4 cases of pulmonary TB (including 1 doctor of the clinic). The doctor and 8 of the TB otitis patients had the TB bacilli with an identical RFLP pattern. The ages of the patients ranged from 5 to 74 for otitis patients, and 2 to 32 for pulmonary cases. Regarding the pulmonary cases, the suspicious source of the infection was the doctor with the smear positive pulmonary TB. However, the source of the infection for the doctor and the otitis cases is unknown, though assumed to be as one of the otitis cases.

These examples are of relatively large scale. In some other cases of particularly large-scale outbreaks, the numbers of the secondary disease patients were 17, 15, and 12 in general hospitals, and 23, 19, and 18 in mental hospitals.

Increase of TB Risk in Health Care Providers

We should not overlook small-scale outbreaks or transmissions of infection with only a few infected cases. These cases are not recorded in the statistics, but have occurred sporadically over the nation and are on the increase. Figure 2 shows the changes in the numbers of TB case notifications since 1987 among female nurses (more accurately, including public health nurses, midwives, and nurses), and teachers and doctors (including physicians, dentists, and physiotherapists). Generally speaking, while the number is on the decrease for the occupation category of “teachers and doctors” (the majority in this category are teachers), the risk
of TB among female nurses shows an increasing tendency.

What would be the reasons for this tendency? First and foremost, the gap in the proportion of those who have been infected with TB between the elderly people and the younger ages has been widening. Among current health care providers in their 20’s and 30’s, only 2 or 3% have been TB-infected. On the other hand, over 70% of the aged patients that they take care of have been infected and can develop clinical TB any time. This gap had not been as wide in the past. This is an epidemiological background for the increase in TB outbreaks in general settings, but is particularly the case in a more extreme form in medical facilities.

The situation has been further worsened by the increase of TB patients in severe conditions. The annual incidence of smear-positive patients increased from 12,291 in 1980 to 17,242 in 1999. Especially among those aged 70 years or over, the number increased threefold. Also, the delay in case detection of TB has to be thought of as the other side of the same coin. This is attributed to the increase of such cases as follows; atypical cases where diagnosis is difficult, acutely progressing types of disease (e.g. when associated with underlying disease); and cases who seek for medical care too late (e.g. as in case of socio-economically disadvantaged people). In addition, the diagnosis of TB has been perhaps further delayed due to the inadequate awareness of TB among medical professions.

**Inadequate Preventive Measure of Nosocomial Infection**

It is also important to remember that the preventive measures taken in Japan for nosocomial tuberculosis have been almost pre-modern. In other words, possible TB patients are taken care of by the personnel as if in the old days, when the majority of the hospital personnel had been infected with TB already.

A recent questionnaire survey shows the actual condition of medical facilities as shown below. The survey refers to the period prior to the Japan Tuberculosis Society’s recommendation for the prevention of nosocomial infection and “Guidelines for the prevention of nosocomial infection of TB” by the research team of the Ministry of Health and Welfare. Therefore, the current conditions are expected to have improved since then. As seen in Table 1, the result reflects the “pre-modernity” of the state of affairs in Japan of the recent past. This should be regarded as one of the important factors for the increase and complexity of incidence of nosocomial infection in the recent years.

**Guidelines for Preventing Nosocomial TB**

Below is a general summary of the preventive measures described in “Guidelines” mentioned above.

1. **Administrative prevention**

Each hospital, with its responsibility to take preventive actions, must develop its own manual for the prevention of nosocomial infection. The manual mandates the establishment and effective management of the committee...
for this issue and the training of hospital employees. In the latter, it is most relevant to keep them more alert to the notion that ‘TB is still around!’ and to thoroughly instruct how to manage a case when it occurs. In addition, the health surveillance with periodic health checkup for TB needs to be provided to the employees, as follows.

1) Health surveillance

The key point is to conduct two-step tuberculin testing in the medical check at the time of employment. If the result is negative, BCG vaccination should be considered. The result of two-step test is an important baseline finding for the interpretation of the tuberculin test result on the occasion of a contact examination in the future. Periodic medical checks including chest X-ray should be obligatory. When a patient in contact with personnel is diagnosed as TB, a special (extraordinary) health examination should be conducted in co-operation with the health center. Tuberculin testing should be included in this examination for those under 40 years of age (as a standard) and the reaction size should be compared with that of the baseline result in the previous two-step test. In addition to the chest X-ray examination right after the contact, follow-up X-ray examination should be done at 6 month interval, during, say, two years.

2) In-patient and outpatient service

Triage of outpatients, i.e. selection of patients who have greater likeliness of having TB and separation of them from other patients, in the outpatient department areas, and isolation of such inpatients into an isolation room. This should be adapted to the conditions of the hospitals, such as its size and the level of risk of TB. Also it is relevant to define the actions to be taken when the examination result of a patient turns out as smear positive, the way of transportation of infectious patient to/from other facilities, etc.

2. Health engineering prevention

The guidelines discuss the ventilation of bed rooms of a hospital, air conditioning, use of filters for cleaning air, etc. It also concerns the plan and the use of such facilities as sputum collection booth and the room for bronchoscopy, and patients’ activities outside the bed room or ward.

3. Personal protections

To instruct patients to wear masks (gauze masks), and hospital staff and patients’ visitors

| Table 1 Preventive Measures for Nosocomial Infection of Tuberculosis Taken by Japanese Hospitals with and without TB Beds (1997, Shishido et al.7) |
|-------------------------------------------------|-----------------|-----------------|
| Health check on employment                      | With TB beds    | No TB beds      |
| Health check on employment                      | (n=179) | (n=170) |
| Inquiry on TB history                           | 77%   | 7%   |
| Tuberculin testing                              | 58%   | 23%  |
| BCG vaccination                                 | 43%   | 12%  |
| Health engineering of TB ward                  | 73%   | —    |
| Separate ward building                         | 73%   | —    |
| Independent air cond. system                   | 27%   | —    |
| Negative pressure bed room                     | 8%    | —    |
| Use of safety cabinet in TB laboratory          | 47%   | 29%  |
| Use of mask                                     | 53%   | —    |
| Obligatory to doctors                           | 53%   | —    |
| Obligatory to nurses                            | 73%   | —    |
situation in the united states

the case rate and mortality rate of tb in the united states are approximately a fifth or sixth of those of japan. however, in the early 1990s the us experienced a reversal of the tb trend, accompanied by outbreaks of nosocomial tb infections, often combined with hiv. under these circumstances, the prevention of nosocomial infection was prudently reviewed. in 1990, the guidelines for preventing nosocomial infection of tb with hiv were issued and in 1994 for preventing nosocomial infection of tb in general. although these are basically comparable to the japanese counterparts, they are far more concrete and in detail. both general hospitals and hiv-related hospitals in the united states seem to have shown rather sensitive responses to such recommendations. manangan et al. observed dramatic changes in hospitals’ schemes on tb prevention (table 2). a direct observation at a hospital conducted by maloney et al. has also revealed the same effect.

the other unique practice in the us is the repeated tuberculin testing followed by chemoprophylaxis among health care providers. this has a subsidiary advantage of enabling to evaluate the risk of the facility as shown in table 2 since bcg vaccination is not used in the united states. however, some have argued that bcg vaccination is clearly more useful because chemoprophylaxis bears a problem of low compliance with the scheme and also because inh is ineffective to infection with multi-drug resistant strain.

while the american experience is not immediately comparable to the situation in japan, we seriously need to consider the differences in the responses to the problem in the two nations; they have been too imprudent in japan.

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