Anaesthetic Management in the Patient with Pulmonary Tuberculosis

Vishwanath R Hiremath¹, Pranjali M Kurhekar², Dilip Kumar G.³

ABSTRACT
Tuberculosis (TB) remains one of the major occupational risk hazards for anaesthesiologist and health care workers in operation rooms in some of the developing countries. Anaesthesiologists do come across providing anaesthesia for patients with active tuberculosis or problems unrelated to tuberculosis like trauma and for various surgeries. As per the World Health Organization (WHO) reporting in 2013, 9 million new cases are supposed to be suffering from TB; among this 2-3% cases are found to be drug resistant. It is true that effective infection control measures and the availability of effective antibiotics for mycobacterium tuberculosis have decreased the risk of nosocomial infection. However, anaesthesiologist and the health workers in the developing countries are still at the risk of tuberculosis transmission from the patients when compared to their counterparts in the developed countries; due to the lack of adequate resources to prevent nosocomial transmission of tuberculosis. Hence, the special precautions need to be under taken by the anaesthesiologist while providing anaesthesia to these patients. From the patient point of view various drug interactions, side effects of anti-tubercular drugs need to be considered preoperatively along with necessary investigations. Immune compromised patients with co infected HIV have a higher risk of developing TB.

Keywords: Tuberculosis, Anaesthesia, Nosocomial Infection, Transmission, Drug resistant

INTRODUCTION
Tuberculosis still remains as one of the world’s commonest communicable diseases. As per the World Health Organization (WHO) reporting in 2013, 9 million new cases are supposed to be suffering from TB; among this 2-3% cases are found to be multi drug resistant (MDR).¹ ² India has high incidence and prevalence of disease with high rate of transmission. Prevalence of all forms of TB in India is estimated to be 5.05 per thousand people. Increasing prevalence of TB in the society definitely has significant impact on anaesthetic management. Anaesthesiologist has to face a number of hazards for anaesthesiologist and health care workers in operation rooms in some of the developing countries. Anaesthesiologists do come across providing anaesthesia to patients with active tuberculosis or problems unrelated to tuberculosis like trauma and for various other procedures. Risk of nosocomial infection to the anaesthetist and other health care providers in operation room environment appears particularly high when there is increased exposure combined with inadequate infection control measures. A thorough preoperative evaluation and investigation is essential along with various drug interactions as well as side effects of anti TB drugs while planning anaesthesia technique.

PATHOPHYSIOLOGY
Tuberculosis is a communicable disease due to the pathogen mycobacterium tuberculosis. The spread is through aerosols; droplets of size 0.5-5 μm. The upper lobe of lung due to its high oxygen tension is usually primary site of infection, Ghon’s focus. Bacteria replicate within macrophages resulting in cell mediated immunity and form granuloma. At this stage patient is asymptomatic with bacteria in dormant condition showing positive response to tuberculin test.² Infect ed patient harbour bacteria and can contaminate anaesthesia machine following general anaesthesia with intubation. Age of the patient (below five years), time of exposure (commonly first year) and competency of the immune system play an important role in the progression of the disease.⁷

DIAGNOSIS
Traditionally, diagnosis is made by visualizing acid-fast bacilli in the sputum. Newer technology, such as the Xpert® M. tuberculosis/resistance to rifampicin or GeneXpert®, make use of real-time polymerase chain reaction to detect specific DNA sequences. They can provide much quicker results (within two hours), as well as information on rifampicin resistance.⁷ Obtaining a sputum sample can be difficult in children, and the diagnosis is usually made on the basis of signs and symptoms of tuberculosis, positive contact and a positive tuberculin skin test (Monteux).⁸ Gastric aspirates can be used, but have a pick-up rate of less than 40%.⁹ T cell interferon-γ (IFN-γ) release assays, which measure the number of IFN-γ-secreting T cells, have been developed as an alternative immune-based approach to the tuberculin skin test to detect infection.¹⁰

TREATMENT
The cornerstone of treatment is directly observed treatment (DOT) for at least six months. First-line treatment includes

¹Professor and HOD, ²Associate Professor, ³Assistant Professor, Department of Anaesthesia and Critical Care, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Kanchipuram, Tamilnadu 603108, India

Corresponding author: Dr Pranjali Kurhekar, Associate Professor, Department of Anaesthesia and Critical Care, Shri Sathya Sai Medical College and Research Institute, Ammapettai, Kanchipuram 603108, Tamilnadu, India

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rifaxamicin, isoniazid (INH), ethambutol and pyrazinamide, given according to guidelines for new cases, retreatment, and children younger than eight years of age.11,14

Tuberculosis treatment has the potential for serious side-effects, some of which may impact on the anaesthetist. Rifampicin can cause thombocytopenia when given in high doses. INH may cause sensory neuropathy, which should be ascertained clinically before performing regional nerve blocks. This complication can be prevented by adding pyridoxine (vitamin B6) in high-risk cases. Ethambutol has the potential to cause optic neuritis. Hence, it is not routinely given to children.

Drug-induced hepatitis is a worrying complication. When tuberculosis treatment is combined with concomitant antiretroviral therapy, a mild elevation in liver enzymes is common. However, symptomatic hepatitis has a mortality of almost 5%11,13, and requires immediate halting of tuberculosis drugs, with careful re-introduction under specialist care. Wherever possible, surgery should be avoided during this period.

ANAESTHETIC MANAGEMENT

The patient of TB may be require anaesthesia for diagnostic procedures (Lymphnode biopsies, Bronchiocopies), complications of tuberculosis (Hydrocephalus, Intestinal obstruction requiring anaesthesia) and elective /emergency surgeries. Three major concerns for the anaesthetist include: general state of the patient’s health (nutrition and anemia), impact of the disease on organ function, and potential drug interactions of antitubercular agents and anaesthetic agents. Further, nosocomial infection transmission to the staff, anaesthetist and other patients is the threat of active disease.

Pre operative assessment of Patient

The preoperative care of these patients involves a thorough assessment involving accurate medical history, physical examination and evaluation of required necessary investigations. Depending on the clinical evaluation, investigations like sputum culture, chest x-ray, PFT, LFT, ABG may be considered. These patients should preferably undergo evaluation in negative pressure ventilated room or isolated room to prevent the spread of aerosol infection. In a known case of TB, sputum smear examination for negative AFB has its own importance. For patients under treatment, sputum smear for AFB taken on three different days need to be negative. It is preferable to postpone the elective procedures until patient is no longer infective. The nutritional status of the patient, anemia, temperature needs to be evaluated and documented. The treatment history includes the details of anti-tubercular drugs and their effects on various organs like liver (rifampicin), nervous system (INH and streptomycin), hematology (thrombocytopenia) and kidney (ethambutol). Drug induced hepatitis is a serious complication in patients with TB associated with HIV. Symptomatic hepatitis is generally responsible for 5% mortality hence TB drug therapy needs to be stopped immediately; if possible surgery should be avoided during this period. Subsequently under strict supervision by specialist, drugs can be restarted. However, during routine anaesthetic management the patient on medication should continue the drugs even on the day of operation with sips of water.

ANAESTHETIC TECHNIQUE

Choice of anaesthetic technique depends on the patient, the procedure and the severity of the disease. Regional anaesthesia is often preferred in patients with chronic lung disease to avoid problems due to disease as such and potential drug interactions (tab 1). Local anaesthetic agents exert their action primarily at the site of injection, and help to avoid many of the drug interactions. Increased metabolism may result in a decreased risk of local anaesthetic toxicity. However, this may not be possible in some procedures and patient may require general anaesthesia. When general anaesthesia is planned drugs should be tailored and planned to limit the expected drug interaction. Hepatotoxic drugs must be avoided.

Recovery from the effect of intravenous induction agents is primarily due to redistribution. Anti TB agents lead to enzyme induction (P-450) which may result in enhanced metabolism of anaesthetic drugs there by accumulation of toxic metabolic products.13 This increased metabolism may have potential for awareness during total intravenous anaesthesia. Inhalational agent, halothane having a potential for hepatotoxicity should be avoided.

Action of depolarizing muscle relaxants (MR) will not be affected until pseudocholine esterase levels are markedly reduced due to severe hepatic dysfunction. Non depolarizing MR atracurium, cis-atracurium (alternate metabolism) and pancuronium (renal excretion) are minimally affected by TB therapy.12 Streptomycin may potentiate the effects of non depolarizing MR hence, NMR have to be titrated as per response with frequent evaluation by nerve stimulator.

The anti TB drug, Rifampicin is known to enhance effect of UDP glucoronoyl transferase involved in metabolism of morphine, thereby reducing efficacy of oral morphine.11 Fentanyl and alfentanil are both extensively metabolized by CYP450 3A4, therefore, also show the potential for a shortened duration of action. Tramadol and brufen can be safely used as their effects are unchanged.11,12

SPREAD OF TUBERCULOSIS

The spread of tuberculosis to other patients especially immunocompromised, anaesthesiologist and theatre staff is an area of concern. Because of the close proximity of the patient’s airway during intubation, mechanical ventilation, suctioning and bronchoscopic procedures anaesthetists are at particular risk.14,16 In 2005, the American Society of Anaesthesiologists (ASA) has come up with guidelines relating to the perioperative management of patients with active tuberculosis.19 Elective surgery should be delayed until the patient is no longer infectious. The ASA defines this as having been on treatment for 2-3 weeks, clinically getting better, and having had three negative sputum smears on different days.

Elective cases should be taken up as the last case of the day followed by fumigation to allow the decontamination of theatre following the operation. The patient should always be transferred to operation room wearing well fitting surgical mask or a N95™mask, brought straight to theatre, rather than waiting in holding area to avoid exposure to other patients. Surgery should be performed with as few personnel as
possible to reduce the number of potential contact with the index patient. To prevent contamination of the anaesthesia machine and circuit high efficiency particulate air (HEPA) filter should be placed between the Y connector and the mask, LMA, or endotracheal tube. Bacterial filters placed on expiratory limb of ventilator or anaesthesia machines may help to reduce discharge of TB bacilli into the ambient air. Sterilization of instruments should follow standard protocols.

Theatre staff also must wear N95® masks, especially true for high-risk procedures, such as intubation and bronchoscopy. The anaesthetist should ensure adequate anaesthesia and muscle relaxation. Unless gas flows are stopped for more than one hour between cases, *M. tuberculosis* has been shown to pass through the anaesthetic machine.18

Post operative care should, if possible, take place in a room with negative pressure or ante room that provides some isolation from outside hallways. However, because most post anaesthesia care units are not so designed, immediate post operative care should be maintained in OR until the patient can be safely transferred to a suitable isolation room. Patients who require intensive care should be placed in private room with the ventilations techniques that needs AFB isolation precautions. The N95® mask should be placed back on as soon as active airway management is no longer required. However, these masks increase airflow resistance by approximately 120%.19 A large venture-type face mask can be placed over the N95® mask to provide supplemental oxygenation. The N95® should not be worn by the patient if he or she is hypoxic or in respiratory distress; if hypoxia or respiratory distress occurs the mask should be removed.

Skin testing program for at-risk staff have been advocated by ASA, as well as in the most recent National Institute for Clinical Excellence guidelines.20 Staff members who receive a positive tuberculin skin test are prescribed INH for 6-9 months. This has been shown to prevent progression to active disease.20-23

<table>
<thead>
<tr>
<th>Drug</th>
<th>Effect of TB treatment</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Induction agents</td>
<td>Unchanged</td>
<td>Beware of risk of awareness with total intravenous anaesthesia</td>
</tr>
<tr>
<td>Volatile agents</td>
<td>An increased risk of halothane hepatitis</td>
<td>Newer agents are preferable</td>
</tr>
<tr>
<td>Local anaesthetic agents</td>
<td>Unchanged</td>
<td>Useful to avoid general anaesthesia and opioids</td>
</tr>
<tr>
<td>Muscle relaxants</td>
<td>Increased metabolism of rocuronium/vecuronium</td>
<td>Titrate/ monitor response using nerve stimulator</td>
</tr>
<tr>
<td>Opiates</td>
<td>Increased metabolism, often more frequent dosing</td>
<td>Titrate to effect. The use of regional technique and patient controlled analgesia is recommended</td>
</tr>
</tbody>
</table>

Table-1: Effects of Tuberculosis treatment on various Anaesthetic agents

**CONCLUSION**

Given the increase in prevalence of HIV and multi drug resistance, tuberculosis will continue to be an important occupational risk for anaesthetists and operation theatre staff. By the virtue of their involvement in procedures that will induce aerosolization of the tubercular bacillus anaesthesiologists are potentially at risk. Hence, it is imperative that anaesthesia personnel should have appropriate training and education regarding the implementation of personal protective practices as well as tuberculin testing. Risk of patient to patient transmission through anaesthesia circuit is low if efficient bacterial and viral filters are used.

**REFERENCE**


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