Management of newborn infant born to mother suffering from tuberculosis: Current recommendations & gaps in knowledge

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Abstract

Tuberculosis (TB) is a global disease with increase in concern with growing morbidity and mortality after drug resistance and co-infection with HIV. Mother to neonatal transmission of disease is well known. Current recommendations regarding management of newborns of mothers with tuberculosis are variable in different countries and have large gaps in the knowledge and practices. We compare and summarize here current recommendations on management of infants born to mothers with tuberculosis. Congenital tuberculosis is diagnosed by Cantwell criteria and treatment includes three or four anti-tubercular drug regimen. Prophylaxis with isoniazid (3-6 months) is recommended in neonates born to mother with TB who are infectious. Breastfeeding should be continued in these neonates and isolation is recommended only till mother is infectious, has multidrug resistant tuberculosis or non adherent to treatment. BCG vaccine is recommended at birth or after completion of prophylaxis (3-6 months) in all neonates.

Keywords: Breastfeeding, congenital tuberculosis, perinatal transmission, prophylaxis, recommendations, therapy

Tuberculosis (TB) is a global public health problem, India and China together account for almost 40 per cent of the world's TB. Congenital infection by vertical transmission is rare with only 358 cases reported till 1995 and another 18 cases reported from 2001 to 2005. High neonatal mortality (up to 60%) and morbidity warrant early diagnosis and treatment of newborns suffering from TB. Existing guidelines for management of the newborns delivered to mothers with TB are variable and have no uniform consensus. An electronic search was carried out at PubMed and Google search engine. The search was limited to literature published in the last 10 yr in English language only. The reference lists of all retrieved articles and guidelines were searched to further identify relevant articles. The key words used were “perinatal, neonatal, congenital, children, childhood, pregnancy, tuberculosis, management, treatment, guidelines” either singly or in different combinations. A manual search was done at both PubMed and Google for guidelines on tuberculosis by eminent organizations like World Health Organization (WHO), Centres for Disease Prevention and Control (CDC), American Academy of Pediatrics (AAP), Indian Academy of Pediatrics (IAP), Merck Manual, and national guidelines in countries like Britain National Institute for Health and Clinical Excellence (NICE), New Zealand (NZ), Revised National Tuberculosis Control
Mother to infant transmission of TB

Congenital infection by vertical transmission of TB is described by transplacental transmission through umbilical veins to the foetal liver and lungs; or aspiration and swallowing of infected amniotic fluid in utero or intrapartum causing primary infection of foetal lungs and gut. Transplacental infection occurs late in pregnancy and aspiration from amniotic fluid occurs in the perinatal period. The diagnostic criteria used for congenital tuberculosis were as described by Beitzke in 1935 and revised by Cantwell et al in 1994.

Cantwell et al proposed diagnosis of congenital tuberculosis in the presence of proven tuberculous disease and at least one of the following; (i) lesions in the newborn baby during the first week of life; (ii) a primary hepatic complex or caseating hepatic granulomata; (iii) tuberculous infection of the placenta or the maternal genital tract; and (iv) exclusion of the possibility of postnatal transmission by investigation of contacts, including hospital staff. In newborns diagnosed of TB, a horizontal spread in the postpartum period by droplet or ingestion from mother or undiagnosed family member is most commonly suggested. Transmission of tuberculosis through breast milk does not occur.

Clinical manifestations of congenital tuberculosis

Infertility, poor reproductive performance, recurrent abortions, stillbirths, premature rupture of membranes and preterm labour are known effects of tuberculosis in pregnancy. The foetus may have intrauterine growth retardation, low birth weight, and has increased risk of mortality. The median age of presentation of congenital TB is 24 days (range, 1 to 84 days). Clinical manifestations are non specific and include poor feeding (100%), fever (100%), irritability (100%), failure to thrive (100%), cough (88.9%), and respiratory distress (66.7%). Examination reveals hepatosplenomegaly (100%), splenomegaly (77.8%), and abdominal distension (77.8%). Lymphadenopathy (38%) lethargy (21%), meningitis, septicaemia, unresolved or recurrent pneumonia, disseminated intravascular coagulation, jaundice, ascitis, otitis media with or without mastoiditis (21%), parotitis, osteomyelitis, paravertebral abscess, cold abscess, and pupular or pustular skin lesions (14%) are other known features. Apnoea, vomiting, cyanosis, jaundice, seizures and petechiae have been reported in less than 10 per cent of cases.

Investigations

Conventional methods: Diagnosis of TB in the newborn depends upon detailed history of maternal infection and high index of suspicion. Antenatal history by gynaecologists and trained nurses is beneficial in early diagnosis and determining neonatal outcome. Morphological and histological examination of placenta in suspected cases at the time of delivery is helpful. Screening of household contacts may yield source of infection. Clinical manifestations in neonates masquerade sepsis, prematurity, viral infections or other acute or chronic intrauterine infections and hence diagnosis is difficult and may be missed. Therefore, in the setting of poor response to antibiotics and supportive therapy, and negative results of microbiological evaluation and serological tests for acute and chronic intrauterine infections, TB should be suspected. Specimens from the neonate suitable for microscopy and culture include gastric aspirates, sputum (induced), tracheal aspirates (if mechanically ventilated), skin lesions, ear discharge, ascitic fluid, cerebrospinal fluid (CSF) and, pleural fluid (if present) for acid fast bacilli and cultured on standard egg based media for 12 wk). Bronchoalveolar lavage (BAL) is an important investigation and detection of Mycobacterium tuberculosis DNA in BAL fluid by polymerase chain reaction (PCR) is diagnostic in...
Liver or lymph node biopsy may be undertaken for histology and culture. Postmortem biopsies (e.g., liver, lung, nodes, and skin lesions) can also be done. Conventional light microscopy (Ziehl-Neelsen or Kinyoun stain) or fluorescence microscopy (auramine stain) are used for detection of Mycobacterium. Chest radiography and computed tomography may show the presence of scattered infiltrates, bronchopneumonia, consolidation or periportal hypodensity which are non-specific. Mantoux test if positive, is supportive evidence, but negative results do not rule out disease. Multiple and repeated investigations may be done in view of high suspicion.

Newer methods: Slow and tedious conventional methods have been recently replaced by quicker methods. The WHO has accredited LED (light emitting diode) fluorescence microscopy and liquid based mycobacteria growth indicator tube (MGIT) in developed countries for fast results. Indirect methods include rapid interferon gamma assays, QuantiFERON-TB Gold assay and T-SPOT using antigens ESAT-6, CFP-10 and TB7 but have shown inconsistent results in newborns. Large trials using Gene Xpert (real time PCR) in children have been useful for rapid diagnosis in communities with a high burden of TB including multiple drug resistant (MDR) tuberculosis. Other mycobacteriophage-based assays like Fast Plaque TB-Rif, molecular line probe assays (LPAs) such as GenoType MTBDR plus assay and the Inno-LiPA Rif TB assay are costly and with only a few studies in newborns.

Management of neonate born to mother with tuberculosis

When a woman suffering from tuberculosis gives birth, the aim is to ensure TB free survival of her newborn infant. It involves diagnosing active tubercular lesion including congenital tuberculosis, and treatment of the neonate or prevention of transmission of tubercular infection to the neonate from the mother. There is no uniformity as is evident from the recommendations of the eminent societies of different countries across the globe (Tables I and II).

(A) Maternal disease and therapy- Extrapulmonary, miliary and meningeal TB in mother are high risk factors for congenital TB in neonates. Vertical transmission from mothers with tubercular pleural effusion or generalized adenopathy does not occur. However, there is a lack of scientific literature regarding increased risk of congenital TB if mothers have resistant TB or concurrent HIV infection. Mothers who have completed antitubercular treatment (ATT) before delivery or have received ATT for at least two weeks duration before delivery are less likely to transmit the disease to the newborn as compared to untreated mothers. Antitubercular drugs are found to be safe in pregnancy except streptomycin in the first trimester. No literature is available regarding the safety of second line antitubercular drugs used for resistant TB in pregnancy.

(B) Prophylaxis - The decision to start isoniazid (INH) prophylaxis to the neonate depends on a number of factors including the history of detection and duration of maternal disease (before or during or after pregnancy), type of tuberculosis (pulmonary or extrapulmonary), and maternal compliance of treatment (regular or irregular). INH prophylaxis is recommended in the neonate if the mother has received treatment for <2 wk, or those who are on therapy for >2 wk but are sputum smear positive. In all other situations there is no need of therapy. American Academy of Pediatrics (AAP) recommends INH prophylaxis to all neonates of mothers who are diagnosed with tuberculosis in the postpartum period and/or after the commencement of breastfeeding has started as these newborns are considered potentially infected. Duration of prophylaxis is guided by skin testing by Mantoux test at three months in New Zealand and by WHO, MERCK Manual and AAP or at 6 months in Malaysia and South Africa. If Mantoux test is negative, prophylaxis is stopped. However, if Mantoux test is positive and evidence of disease is found, ATT is started. If there is no evidence of disease in Mantoux positive neonates, then INH may be given for six months or 9 months. IAP does not comment on maternal treatment or Mantoux test
and suggests isoniazid therapy to all newborns for at least 6-9 months or a minimum for three months until mother is culture negative. There is also a variation in the dose recommended for prophylaxis with 5 mg/kg, 15 mg/kg, and 10 mg/kg.

(C) Nutrition and breastfeeding - Support for breastfeeding is crucial for the survival of the newborn. Human milk in addition to providing nutrition has immunological benefits and all efforts to continue breastfeeding in newborns with mothers having tuberculosis should be made. In case of maternal sickness or if mother is smear positive at the time of delivery or mothers with MDR TB, when breastfeeding may not be possible, expressed breast milk feeding is an alternative, with personal hygiene. AAP recommends continued feeding with expressed milk in mothers with pulmonary TB who are contagious, untreated or treated (< 3 wk) with isolation. WHO recommends feeding under all circumstances, however, close contact with the baby should be reduced. Malaysian Thoracic Society recommends that if mother is contagious, efforts should be made to use expressed maternal milk for feeding. There is a paucity of scientific literature on the increased risk of neonatal transmission by breastfeeding in the presence of factors such as infection with resistant organisms (multiple or extensive drug resistance or co-infection with human immunodeficiency virus. First line ATT is secreted in milk in small quantity and causes no adverse effect on the child.

(D) Isolation and barrier nursing – Isolation is recommended when mother is sick, non adherent to therapy or has resistant TB or received ATT four less than 2 wk or three weeks before starting ATT. Barrier nursing using face mask (20-22) and appropriate cough hygiene has been advised for the mothers who are breastfeeding. Hand washing, disinfecting nasal secretions and baby wipes are recommended by AAP.

(ii) Diagnosis, treatment and follow up (A) Mantoux test - Utility of Mantoux test in neonates is poor due to low reactogenicity and poor helper T cell responses. In a study by Hageman et al only two of the 14 infants with congenital TB had positive tuberculin tests. Current recommendations support use of Mantoux test after three months or six months. Exact cut-off (> 5, 5-10 and >10 mm) and strength of purified protein derivative (PPD) (1 or 5 or 10 TU) in newborns. IAP in the recent recommendations has decreased the strength of PPD for skin testing to 2 TU.

(B) Treatment – No specific treatment regimens for congenital tuberculosis are advised. Treatment includes isoniazid, rifampicin, ethambutol and kanamycin or amikacin for the first two months followed by isoniazid and rifampicin for 6-12 months or similar to miliary tuberculosis or isoniazid, rifampicin and pyrazinamide along with streptomycin and kanamycin for 9 to 12 months.

(C) Follow up - Neonates diagnosed and treated for congenital tuberculosis should be monitored while on therapy, but no details regarding the timing or the modes of monitoring exist. DOTS recommends chest X-ray at the end of treatment. American Academy of Pediatrics suggested that infants receiving prophylaxis should have clinical surveillance. In a study periodic X-ray and Mantoux test have been advised at 6, 12 and 24 wk.

(iii) Long term protection Bacillus Calmette Guerin (BCG) vaccination protects against the dissemination of tuberculosis and severe disease. In neonates with congenital tuberculosis there is no utility of BCG vaccine. In neonates receiving INH prophylaxis, BCG vaccine (timing not specified) is recommended. WHO recommends BCG vaccine until completion of INH therapy. AAP has advised BCG vaccine after completion of chemoprophylaxis at six months or at birth along with isoniazid if follow up cannot be ensured. The New Zealand guidelines recommend BCG after three months of prophylaxis while in South Africa SASPID recommends it after six months of prophylaxis.
recommends BCG vaccination after ruling out congenital TB and again after the INH prophylaxis if scar is absent. Indian Academy of Paediatrics advises BCG vaccination at birth to all neonates after excluding congenital tuberculosis even if chemoprophylaxis is planned. Hence it is evident that there is no consensus on the number, timing and interpretation of BCG vaccination in infants born to women with TB. In countries with significant number of TB patients in the community children are vulnerable to get TB infection early in life: Therefore, BCG vaccination as early as possible preferably after stopping of INH prophylaxis should be followed. There is an urgent need to conduct more studies to evaluate immunogenicity of BCG vaccine in infants receiving INH prophylaxis.

References


27. Lamounier JA, Moulin ZS, Xavier CC. Recommendations for breastfeeding during maternal...


**Figures and Tables**

### Table I

<table>
<thead>
<tr>
<th>Diagnosis of congenital tuberculosis</th>
<th>Treatment of congenital tuberculosis</th>
<th>Prophylaxis</th>
<th>Follow up</th>
<th>Level of evidence</th>
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<tr>
<td>IAP(^{22})</td>
<td></td>
<td>INH therapy (10 mg/kg) for 6 months after ruling out congenital TB</td>
<td></td>
<td>Not mentioned</td>
</tr>
<tr>
<td>DOTS/RNTCP(^{29})</td>
<td></td>
<td>INH prophylaxis for 3 months. Do a Mtx test if negative, stop INH. If positive, search for TB and give treatment</td>
<td></td>
<td>Not mentioned</td>
</tr>
<tr>
<td>AAP(^{20})</td>
<td>Mtx, CXR, LP, appropriate cultures, placental histology</td>
<td>INH for 3-4 months followed by Mtx test. If Mtx negative stop INH by 3 months. If Mtx is positive, a search for disease is made. If disease is positive then treat as congenital TB, if no disease give INH for 9 months</td>
<td>Monthly while on INH prophylaxis. Mtx to be repeated at 6, 9, 12 months. if Mtx is positive investigate for TB and continue INH</td>
<td>Not mentioned</td>
</tr>
<tr>
<td>WHO(^{31})</td>
<td>Cantwell criteria</td>
<td>INH for 6 months. If Mtx negative, INH stopped. BCG after 2 weeks if Mtx is negative</td>
<td></td>
<td>Question not answered under level evidence</td>
</tr>
<tr>
<td>New Zealand guidelines on tuberculosis(^{27})</td>
<td>Mtx test, CXR, LP, cultures, microscopy and culture of gastric aspirate, biopsy tissue (lymph nodes, bone marrow, liver) or placental tissue. CSF also recommended</td>
<td>INH, rifampicin, ethambutol and amikacin or kanamycin for first 2 months and INH, rifampicin for 6-12 months depending</td>
<td></td>
<td>Not mentioned</td>
</tr>
<tr>
<td>Merk Manual(^{23})</td>
<td>Culture of tracheal aspirate, CXR, Mtx, CSF, placental examination</td>
<td>INH for 3-4 months and then Mtx. After ruling out disease INH can be stopped. If Mtx is positive, but no disease then continue</td>
<td></td>
<td>Not mentioned</td>
</tr>
</tbody>
</table>

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4181157/?report=printable
### Comparison of recommendations on prophylaxis, diagnosis and treatment guidelines by different groups

<table>
<thead>
<tr>
<th>Disease category</th>
<th>WHO for newborn infant born to mother with active pulmonary TB</th>
<th>Award for newborn infant born to mother with active pulmonary TB</th>
<th>MTS*</th>
<th>SASPID**</th>
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<tr>
<td>Active TB</td>
<td>INH for 9 months under monitoring</td>
<td>After ruling out congenital tuberculosis and prophylactic INH treatment to infants born to mother with active pulmonary TB except those diagnosed more than 2 months before delivery and are documented with smear negative before delivery (Grade C). Prophylactic INH to be given for 6 months or alternatively 3 months of isoniazid followed by Mtx if negative treatment stopped, if positive (&gt; 5mm) treatment for 6 months followed by BCG (Level III). If mother is diagnosed of pulmonary TB after delivery, INH and rifampicin for 3 months or INH alone for 6 months may be given</td>
<td>Mtx, RNTCP, AAP, WHO</td>
<td>Mtx, RNTCP, AAP, WHO, BCG, BCG, BCG, BCG</td>
</tr>
</tbody>
</table>

**Intra-African comparison**

- 3 drug regime or treat like military TB
- INH (8-12mg/kg) for 6 months
- Close follow up of children for clinical status adherence to INH prophylaxis
- Not mentioned

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IAP, Indian Academy of Pediatrics; DOTS, Directly Observed Treatment- short course; RNTCP, Revised National Tuberculosis Programme; AAP, American Academy of Pediatrics; WHO, World Health Organization; ATT, Anti-tubercular Treatment; BCG, Bacille Calmette-Guérin Vaccine; MTS, Malaysian Thoracic Society; SASPID, Southern African Society for Paediatric Infectious Diseases; MDR-TB, Multi Drug Resistant Tuberculosis; Mtx, Mantoux Test; PPD, Purified Protein Derivative Test (Tuberculin test)
<table>
<thead>
<tr>
<th>Name of the group</th>
<th>Breast Feeding</th>
<th>Barrier method</th>
<th>Isolation</th>
<th>BCG Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>IAP²⁴</td>
<td>Can continue to breast feed.</td>
<td>Cough hygiene</td>
<td>Not required if mother on treatment. Isolation if mother hospitalized, non-adherent to therapy or has MDR-TB.</td>
<td>Advised at birth even with INH prophylaxis (IAP 2012)</td>
</tr>
<tr>
<td>DOTS²³</td>
<td>Feeding encouraged if mother sputum negative</td>
<td>Face mask</td>
<td>If mother has active disease and is noncompliant to treatment or has received ATT prior to delivery.</td>
<td>Vaccination may be postponed or done with INH resistant BCG vaccine. Not mentioned.</td>
</tr>
<tr>
<td>AAP²⁰</td>
<td>Breast feeding if mother is on ATT</td>
<td>Face mask</td>
<td>Separation avoided. Advised if MDR-TB, non-compliant to therapy, mother has contagious TB before starting ATT.</td>
<td>Give BCG if mother has MDR-TB, or poorly adherent to treatment. Not mentioned.</td>
</tr>
<tr>
<td>WHO²¹</td>
<td>To continue</td>
<td>Face mask</td>
<td>If mother has MDR-TB.</td>
<td>Delay BCG until INH therapy is completed. BCG after 2 weeks of completing therapy. Question not answered under level evidence.</td>
</tr>
<tr>
<td>New Zealand Guidelines On Tuberculosis²²</td>
<td>Recommended irrespective of the maternal status</td>
<td>Mask and infection control measures</td>
<td>Separation till mother fully evaluated or until both are on treatment, if mother has MDR-TB or poor adherence to therapy; infant on isoniazid therapy needs no separation.</td>
<td>BCG after 3 months of INH therapy. Not mentioned.</td>
</tr>
<tr>
<td>MERK MANUAL²⁵</td>
<td>Breast feeding not contraindicated</td>
<td>-</td>
<td>Mother and baby should stay together.</td>
<td>If mother non adherent BCG should be given. Not mentioned.</td>
</tr>
<tr>
<td>MTS²⁴</td>
<td>Give expressed breast milk till mother sputum smear negative</td>
<td>-</td>
<td>If mother smear positive at time of delivery.</td>
<td>BCG at birth if congenital TB ruled out. (level III) BCG should not be given to babies on prophylactic TB treatment (Grade C) After completing INH prophylaxis for 3 months monotherapy if negative BCG administered or if positive BCG at 6 months. In babies born to mothers with active PTB &lt; 2 months after delivery BCG may be repeated but no role of reimmunizing babies if mothers diagnosed of active pulmonary TB after 2 months of delivery. (level III)</td>
</tr>
<tr>
<td>SASPID²⁵</td>
<td>Mother should be encouraged to breast feed</td>
<td>-</td>
<td></td>
<td>BCG after 6 months of INH therapy or after completing treatment. Not mentioned.</td>
</tr>
<tr>
<td>NICE²⁶</td>
<td>Breast feeding allowed</td>
<td>-</td>
<td>Mother and baby should not be separated</td>
<td></td>
</tr>
</tbody>
</table>

AAP, American Academy of Pediatrics; ATT, Antitubercular Treatment; BCG, Bacille Calmette-Guérin Vaccine; CDC, Centers for Disease Control and Prevention; DOTS, Directly Observed Treatment - short course; MDR-TB, Multi Drug Resistant Tuberculosis; MTB, Mantoux Test; PPD, Purified Protein Derivative Test (Tuberculin test); WHO, World Health Organization; MTS, Malaysian Thoracic Society; NICE, National Institute for Health and Clinical Excellence
Comparison of recommendations on isolation, breast-feeding and vaccination by different groups