String test: a new tool to improve the diagnosis of tuberculosis

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**BACKGROUND**

- Specimen collection is a challenge for diagnosis of pulmonary tuberculosis (TB) in adults unable to produce sputum and in children
- Gastric aspiration and sputum induction can be difficult to implement in outpatients settings
- String Test is an intragastric device used for entero-pathogens retrieval
- There are few data on the use of string test for diagnosis of TB

**OBJECTIVES**

- To compare microscopy and culture detection yields using string test (ST) and sputum induction (SI) for the diagnosis of TB
  - In adults TB suspects unable to produce sputum
  - In children TB suspects
- To assess tolerability, acceptability and feasibility of string test and sputum induction

**METHODS**

**Inclusion criteria**

- **Adults**
  - ≥15 years
  - Cough >2 weeks, or chronic unexplained weight loss/fever, or CXR suggestive of TB
  - Unable to produce sputum
  - Signed informed consent
- **Children**
  - 3-14 years
  - Suggestive symptoms +
    - TB contact history or
    - Positive Mantoux or
    - Suggestive chest X-ray or
    - No response to antibiotic trial

**Exclusion criteria**

- Anti-TB treatment >1 week during previous month
- Contraindication of SI
- Too sick to handle procedures

**Procedures**

Collection of 2 specimens: on spot and morning
- ST: Enterotest; HDC corporation, CA, USA (1USD)
  - After at least 2 h or overnight fa
  - 2 hours intra-gastric downtime
  - End of string in 2ml of sterile 0.9% NaCl + centrifugation
- SI done after ST: nebulization of 15mL of 5% NaCl to a maximum 20 min

**Tests**

- Fluorescent LED-microscopy
- Culture (MGIT and Lowenstein Jensen)

Tolerability assessed using behavioural Pain Scale (Campbell, Detroit Medical Centre 2000)

**RESULTS**

### Patients’ characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Adults N=210</th>
<th>Children N=137</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age years, median (IQR)</td>
<td>34 (26, 45)</td>
<td>8.1 (3.7,14.1)</td>
</tr>
<tr>
<td>Gender ratio, male : female</td>
<td>101 : 109</td>
<td>66 : 71 (0.9)</td>
</tr>
<tr>
<td>HIV positive, n (%)</td>
<td>117/198 (59.1)</td>
<td>43/129 (33.3)</td>
</tr>
</tbody>
</table>

**TB detection yields using microscopy and culture for patients with both ST and SI tests**

<table>
<thead>
<tr>
<th></th>
<th>ST n (%)</th>
<th>SI n (%)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adults</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microscopy, n=187</td>
<td>26 (13.9)</td>
<td>25 (13.4)</td>
<td>1.0</td>
</tr>
<tr>
<td>Culture, n=182</td>
<td>42 (23.1)</td>
<td>45 (24.7)</td>
<td>0.18</td>
</tr>
<tr>
<td>Children</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microscopy, n=106</td>
<td>5 (4.7)</td>
<td>4 (3.8)</td>
<td>1.0</td>
</tr>
<tr>
<td>Culture, n=105</td>
<td>9 (8.6)</td>
<td>9 (8.6)</td>
<td>1.0</td>
</tr>
</tbody>
</table>

**TB detection yields using XpertMTB/RIF assay culture for patients with both ST and SI tests**

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<tbody>
<tr>
<td>Adults</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST: 15/96, 15.6%</td>
<td></td>
<td>ST:5/70, 5.7%</td>
</tr>
<tr>
<td>SI: 17/96, 17.7%</td>
<td></td>
<td>SI: 6/70, 8.6%</td>
</tr>
<tr>
<td>McNemar test: p=0.375</td>
<td>McNemar test: p=0.317</td>
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**Feasibility and tolerability**

<table>
<thead>
<tr>
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<th>Adults</th>
<th>Children</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure failures, n/N (%)</td>
<td>1/204 (0.5)</td>
<td>14/204 (6.9)</td>
</tr>
<tr>
<td>(refusals and not done excluded)</td>
<td>30/248 (12.1)</td>
<td>26/261 (10.0)</td>
</tr>
<tr>
<td>Tolerability score, median (IQR)*</td>
<td>5 (5,5)</td>
<td>5 (5,5)</td>
</tr>
<tr>
<td>Ease of Use score**, median (IQR)</td>
<td>2 (1,3)</td>
<td>2 (1,2)</td>
</tr>
</tbody>
</table>

*0 very well tolerated to 10 badly tolerated
** 0 very easy to 10 very difficult

**Safety of the string test**

Cough in 2.4% of adults and 7% of children
Vomiting in 1% of adults and 5.2% of children

**DISCUSSION**

Similar detection between ST and SI in both adults and children
Able to confirm TB in 20% of adults unable to produce sputum
Low detection yield for both ST and SI in children

**ST**

- Implementation
- Length of procedure

**Disadvantages**

- Size of capsule
- Only for older kids
- Tolerability
- Availability of device

**SI**

- Implementation
- Logistics
- Training

**CONCLUSION**

ST is an effective, safe and easy to use method to collect specimens in adults unable to produce sputum
Smaller size of capsule would improve the acceptability in young children

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