A small audio device may be alternative to hypertonic saline inhalation for sputum induction in patients with pulmonary tuberculosis.

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Introduction (1)

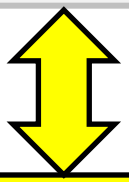
Sputum examination is a key diagnostic procedure for pulmonary tuberculosis (TB).

✓Patients suspected of having pulmonary TB disease

✓Patients suspected of having pulmonary TB disease for which bronchoscopy is planned

(Sputum specimens should be collected and results of staining for AFB should have been reviewed before bronchoscopy.)

AFB: acid-fast bacillus



But some patients cannot produce sputum.
In such cases, sputum induction with aerosol inhalation has been preferred.
Hypertonic saline inhalation causes discomfort in throat and bronchoconstriction in asthmatic patients.

Introduction (2)

The Lung Flute® (Medical Acoustics, Buffalo, NY) is a small self-powered audio device that generates 18 to 22Hz with an output of 110 to 115 dB using 2.5cm H_2O of pressure.

This sound wave, when generated at the mouth by mild exhalation, travels retrograde down the tracheobronchial tree and hypothetically it vibrates tracheobronchial secretions.

Analysis revealed that the samples obtained using the Lung Flute® were not statistically different as compared with the induction sputum through hypertonic saline inhalation in patients with chronic bronchitis. (Sanjay Sethi, et al)

The Lung Flute® approved by the US FDA (2006) and EU (2007) for sputum induction for diagnostic purposes.

Objective

To evaluate the diagnostic yield of sputum sampling by the audio device (the Lung Flute®) method in patients with pulmonary TB.

We compared the results with that of hypertonic saline inhalation (HSI) for the diagnosis of pulmonary TB.

However, this is not a controlled study. We applied this device method preliminarily, then compared to conventional HSI retrospectively.

Patient Selection

1. Patients referred to the TB clinic in Tokyo Metropolitan Fuchu Hospital (a 761-bed tertiary hospital) after screening with symptoms and chest X-ray at primary care clinics.
2. Patients aged 18 and over.
3. Chest X-ray lesions such as scattered infiltrates and/or cavities suggesting pulmonary TB.
4. Need to examine sputum for making diagnosis of TB.
5. No spontaneous sputum at the first visit.
6. Bacteriological diagnosis of TB in principle (regardless of specimens), but clinical diagnosis (QuantiFERON TB-2G, etc) in some cases.

Exclusion:

- Hypoxemia below 90% by pulse oxymetry or equivalent
- Bronchial asthma

Methods

1. The audio device: the Lung Flute® (n=15)
- Experimental use in Tokyo Metropolitan Fuchu Hospital (Not cleared by the authority in Japan)
- From Dec. 2006 to Nov. 2007
- Written informed consent
- One device for each patient

2. Conventional hypertonic saline inhalation with nebuliser (n=11)
- The clinical practice during the same period
- In two cases, after using the audio device

3. Single induction in each method
4. On a day or a near day of the first visit
5. In the negative ventilation room for the patients with suspected infectious TB
6. Follow-up time to producing sputum was maximum 30 minutes after the session.

Conventional Hypertonic Saline Inhalation

A) 20mL of 3% sodium chloride solution (5 cases)
Ultrasonic nebuliser (OMRON® NE-U12, Japan)
Wearing mask through a tube within 10 minutes

B) 3 - 5mL of 10% sodium chloride solution (6 cases)
Compressor nebuliser (PARI BOY® Type038)
Through a mouthpiece within 5 minutes

- Ultrasonic nebulisers are recommended by the ERS working group.
- As regards hypertonic saline, 10% NaCl solution is commercially available in Japan.
- The success rates of sputum production were not different between the method A and B in patients with various respiratory diseases. (K.Murata, A.Fujita, Japan Society of Respiratory Endoscopy Conference, 2008)

Microbiological Examination

1. Specimens were homogenized with mucolytic agent (N-acetyl-L-cysteine) and decontaminant (1–2% sodium hydroxide solution) to render the bacterial contaminants nonviable.

2. Smears were prepared directly from specimens and reconfirmed from concentrated preparations. AFB in stained smears was examined microscopically by the fluorochrome procedure.

3. Polymerase chain reaction (PCR) was applied to specimens with AMPLICOR MTB assay (Roche), regardless of AFB-smear results.

4. All specimens cultured using the Mycobacterial Growth Indicator Tube (MGIT) systems (Becton Dickinson). *M. tuberculosis* was confirmed by an immunochromatography using anti-MPB64 monoclonal antibodies named Capilia TB assay (Japan Becton Dickinson, LTD).

Patient Characteristics

	Audio device (the Lung Flute®)	Hypertonic saline inhalation alone *
Number of cases	15	9
M/F **	5/10	5/4
Age	47 +- 19	48 +- 17
Non /Ex /Current smoker **	9 / 3 / 3	5 / 2 / 2
X-ray findings **		
Cavity	2	2
Unilateral shadow	8	6
Bilateral shadow	7	3

* 2 cases were undertaken HSI after the device.
Patients who inhaled hypertonic saline totaled 11.
** number of cases

Rapid Diagnostic Yields of Using the Lung Flute® or Hypertonic Saline Inhalation in TB Patients

	The Lung Flute® (n=15)	Hypertonic saline inhalation (n=11)	
Sputum production	12 (80%)	10 (91%)	N.S.
Rapid diagnostic yield	7 (47%)	4 (36%)	N.S.
AFB-smear positive /PCR positive	3*	1*	
AFB-smear negative /PCR positive	4*	3 (2*)	

* MGIT positive and Capilia TB assay positive

AFB-Culture Results by Using the Lung Flute® or Hypertonic Saline Inhalation in TB Patients

	The Lung Flute® (n=15)	Hypertonic saline inhalation (n=11)	
Rapid diagnosis /Culture positive	7 (47%)	3 (27%)	N.S.
No rapid diagnosis /Culture positive	1 (7%)	3 (27%)	N.S.
Smear negative /Culture negative	4*	2**	
Bacteria contamination during MGIT culture	0	2** (1#)	

* 2 were diagnosed by bronchoscopy, one was AFB-culture positive sputum on a later day, and one was clinically diagnosed.

*** 2 cases were undertaken HSI after the device; one still made no sputum, another expectorated sputum of negative AFB-smear and negative culture.

A NOVEL METHOD FOR SPUTUM INDUCTION BY THE LUNG FLUTE®
IN PATIENTS SUSPECTED OF PULMONARY TUBERCULOSIS
A. Fujita, et al. 2007, 12th Annual APSR Congress

Adverse Events Associated with Use of the Lung Flute® (n=34)

Sore throat	4 (12%)
Hyperventilation related symptoms	3 (9%)
Dizziness	2 (6%)
Headache	1 (3%)
Breathing discomfort	1 (3%)

(no need to Rx.)

Summary

1. One to 5mL sputum samples could be collected in 12 of 15 patients (80%) after using the device. Induced specimens by HSI were obtained in 10 of 11 patients (91%).

2. The device yielded rapid TB diagnosis in 7 of 15 cases (47%) ; 3 were AFB-smear positive and 4 were AFB-smear negative but TB-PCR positive. HSI yielded rapid TB diagnosis in 4 of 11 cases (36%).

3. Of two patients undertaken HSI after using the device, one still made no sputum and another expectorated sputum of negative AFB-smear and negative culture.

4. The audio device (the Lung Flute®) does not require special equipment in medical facilities. The Lung Flute® is non-invasive and it may provide a rapid and effective method of sputum induction.

Conclusion

The diagnostic yield for pulmonary TB of the audio device (the Lung Flute®) seemed to be acceptable.

It may be an alternative method to hypertonic saline inhalation (HSI) for the diagnosis of pulmonary TB.

Further studies are needed to determine whether the Lung Flute® is not inferior to HSI for the diagnosis of TB.