Induced Sputum Versus Fiberoptic Bronchoscopy in The Diagnosis of Pulmonary Tuberculosis

Amr A. Darwish, Ahmed A. Ali, Wafaa A. Zahran*, Nourane Y. Azab and Mohammed A. Agha

Chest & Microbiology and Immunology* Departments Faculty of Medicine, Menoufiya University

Tuberculosis still constitutes a major health problem despite advances in diagnosis and treatment. The diagnosis of TB is difficult in patients who cannot produce sputum spontaneously. This study aimed to compare between sputum induction using nebulized hypertonic saline, and fiberoptic bronchoscopy in the diagnosis of pulmonary TB, in clinically and radiologically suspected cases.

Methods: Thirty suspected pulmonary tuberculosis cases were subjected to: 1-Tuberculin skin test. 2-Sample collection: a. Three successive spontaneous morning sputum samples, b. Sputum induction for 3 successive mornings c. Fiberoptic bronchoscopy with bronchial washing, brushing & Post-bronchoscopic sputum collection. All samples were stained with Ziehl-Neelsen stain. Induced sputum (SI) and bronchial wash were also cultured on Lowenstein-Jensen (L.J) medium. Results: According to L J cultures there were 25(83.3%) positive bronchial wash samples VS 22(73.3%) induced sputum samples. The diagnostic yields of sputum induction and post-bronchoscopic sputum were similarly significant. Also, the yields of bronchial washing and bronchial brushing were similarly highly significant. The differences between all these procedures was non significant. The third SI sample was the most sensitive in the detection of AFB There was no significant difference between SI & Bronchial washing whether by using Z-N stain or L-J culture. Sensitivity, specificity and predictive values of different methods of specimen collection in diagnosing pulmonary TB gave non-significantly different results.

Conclusion: Sputum induction is an easy, cheap and non invasive procedure that has a significantly high diagnostic yield for clinically and radiologically suspected cases of pulmonary tuberculosis who have dry cough or whose sputum for three successive days are negative. The third SI sample is the most significant one. There is no significant difference between SI and FOB using any of its procedures.

INTRODUCTION

Tuberculosis had coexisted with humanity before recorded history. In spite of the major advances in the diagnosis, treatment and prevention of TB, it remains one of the major public health problems worldwide, with 95% of cases and 98% of deaths occurring in developing countries (1). In Egypt, TB is the second most important health problem after bilharziasis (2). The continuous threat of TB had lead to an urgent need for effective diagnostic procedures (3). The clinical diagnosis of pulmonary tuberculosis is quite variable & its radiological diagnosis is only suggestive, so the identification of organisms is so critical (3). Culture remains the gold standard method for the diagnosis of MTB, nevertheless several nucleic acid based techniques have been developed for its diagnosis. Mycobacterial culture is much more sensitive than microscopy, being able to detect as few as 10 bacteria/ml of material (3).

For more than 3 decades, sputum induction (SI) has been widely used as a non-invasive tool for the diagnosis of tuberculosis (3). Sputum induction helps to wash off mucous from the bronchial tree and its hypertonicity irritates and induces osmotic transudation of fluid across the bronchial tree membrane (4). However, with the advent of fiberoptic bronchoscopy (FOB), sputum induction was largely abandoned. Recently, it has enjoyed a modest revival because of its safety, and much lower costs (5).

The fiberoptic bronchoscope was first used in diagnosing tuberculosis in 1975, to establish the diagnosis of tuberculosis in patients presenting with clinical and radiological manifestations suggestive of pulmonary tuberculosis, but having negative sputum for AFB by direct microscopic sputum examination (6).
This work aimed at comparing between sputum induction using nebulized hypertonic saline, and fiberoptic bronchoscopy in the diagnosis of pulmonary TB, in clinically and radiologically suspected cases.

SUBJECTS & METHODS

This study included 30 patients, admitted to chest department Menoufiya University Hospital during the period from October 2003 to July 2004. They were 17 males and 13 females, their ages ranged between 18 and 62 ys. All these patients had clinical picture and radiological findings suggestive of pulmonary tuberculosis. They had either dry cough or their sputum examination by direct smear using Ziehl-Neelsen stain (Z.N) for 3 successive days was negative.

All Patients Were Subjected To:
- Full history taking with stress on history of immunosuppressive therapies, BCG vaccination and Diabetes.
- Plain chest X-ray.
- Routine laboratory investigations including complete blood count, ESR, fasting and post brandial blood sugar.
- Tuberculin skin test (Mantoux method) was performed using purified protein derivative PPD (Vacsera)0.1 ml (5 tuberculin units). Induration > 10 mm was considered positive.
- Microbiological examination:
  - Three successive morning samples were stained using Ziehl-Neelsen stain. If they proved to be negative for AFB or when the sputum can not be obtained, the patients were subjected to:
    a- Sputum induction for 3 successive mornings by hypertonic saline (2.7%) using ultrasonic nebulizer (Midmark, ultra-sonic nebulizer), and the samples were sent for microbiologic examinations.
    b- Fiberoptic bronchoscopy (FOB) (Pentax FB, 19-TV) was done on another day after collection of induced sputum samples.
  1- Bronchial wash. A 30 ml 0.9% sterile saline is injected through the side channel of FOB, into the main bronchus or the lobar bronchus which harbors an abnormal shadow on X-rays. The fluid was immediately pooled in a sterile bottle and sent to the microbiology Lab.
  2- Bronchial brushing under direct vision from proximal areas of suspicion or from more peripheral sites, that were determined from chest X-rays. The brush was smeared directly onto a microscope slide and stained using Z.N stain.
  3- Post-bronchoscopic sputum collection: After patient's recovery from sedation, he was instructed to cough deeply to expectorate in a sterile wide-mouthed screw capped plastic container during the following few hours.

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- Ziehl-Neelsen stained smears were performed from all samples (before and after decontamination), examined and reported according to Forbes et al.
- Digestion, decontamination with N-acetyl cysteine (NALC)- Sodium hydroxide solution (BBL Mycoprep specimen kit) and concentrated by centrifugation.
- The sediments were resuspended in 3 ml phosphate buffer (0.067M, pH6.8) containing 0.5% Tween 80 to homogenize the sediments which were inoculated on L-J culture media (Oxoid). Cultures were examined daily for one week, then weekly for 8 weeks. Mycobacterial growth was diagnosed on basis of colonial morphology, rate of growth and ZN stain.
- Quality control slides and cultures were included with each run. These were prepared from MTB H37Ra ATCC 25177 (positive control) and E.coli ATCC 25922 (negative control).
- Quality control of decontamination capability was also determined for each new batch of reagents by inoculating decontaminated samples on blood agar. Only minimal to no contaminants should grow after 24-48 hs of incubation.
- Cultures on ordinary media to diagnose other pathogens were also performed before sample decontamination.
- Data were collected, tabulated, statistically analyzed by computer using SPSS version 10. The tests used were:
  1- Chi-square test (X²): to study statistical relation between different qualitative variables.
  2- Z test = when there is one variable. Sensitivity, specificity, positive predictive value and negative predictive value were calculated using Bay's formula.
Level of significance was set as P. value < 0.05.

RESULTS
The study included 30 clinically and radiologically suspected cases of pulmonary tuberculosis, 25 cases were proved to be positive by bronchial wash LJ cultures.
Among the 30 investigated patients, 12 were diabetics, 10 of them were tuberculous.
-Nine patients had negative tuberculin skin tests, (5 of them were false negative), while 21 patients had positive test, (with only one false positive case). So, the sensitivity of tuberculin skin test was 80%, specificity 80%, positive predictive value (PPV) 95.2% and negative predictive value (NPV) 44.4%.
-Using ZN stained smears the diagnostic yield of sputum induction was significant and similarly was that of post-bronchoscopic sputum as 20 patients (66.7%) proved to be tuberculous by both methods. Also, the yields of bronchial washing and bronchial brushing were similarly highly significant since, 23 patients (76.7%) proved to be tuberculous by both procedures. (Table 2).

The differences between all these procedures was non significant (p>0.05).
- The sensitivity, specificity, PPV and NPV of ZN using different samples were recorded in table (3)
-Of the 3 induced sputum samples, the third one was the most sensitive in detection of AFB (19 cases). While, the first sample was the least since it only detected 10 cases table (4).
-The LJ cultures also show highly significant diagnostic yields using either SI (73.3%) or bronchial washing (83.3) methods table (5).

Using ZN smears, 20 samples of SI, (66.7%) positive VS 23 (76.7%) bronchial wash samples significant difference between SI and bronchial washing by LJ cultures (p > 0.05) as shown in table (6)
There was no significant difference between post-bronchoscopic sputum and bronchial washing, post-bronchoscopic sputum and bronchial brushing or between SI and bronchial brushing in detecting positive cases

Table (1): Tuberculin skin test among proved tuberculous patients

<table>
<thead>
<tr>
<th>Tuberculin test</th>
<th>+ve TB</th>
<th>-ve TB</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
</tr>
<tr>
<td>-ve tuberculin</td>
<td>5</td>
<td>16.7</td>
<td>4</td>
</tr>
<tr>
<td>+ve tuberculin</td>
<td>20</td>
<td>66.7</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>83.3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table (2) Results of Z.N staining using the different methods of specimen collection

<table>
<thead>
<tr>
<th>Z.N stain</th>
<th>Positive</th>
<th>Negative</th>
<th>Total</th>
<th>Z-test</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SI</td>
<td>20</td>
<td>66.7</td>
<td>10</td>
<td>33.3</td>
<td>30</td>
</tr>
<tr>
<td>Bronchial washing</td>
<td>23</td>
<td>76.7</td>
<td>7</td>
<td>23.3</td>
<td>30</td>
</tr>
<tr>
<td>Bronchial brushing</td>
<td>23</td>
<td>76.7</td>
<td>7</td>
<td>23.3</td>
<td>30</td>
</tr>
<tr>
<td>Post- bronchoscopic sputum</td>
<td>20</td>
<td>66.7</td>
<td>10</td>
<td>33.3</td>
<td>30</td>
</tr>
</tbody>
</table>

- S: Significant (P< 0.05). - H.S: Highly significant (P< 0.01)

Table (3) Sensitivity, specificity and predictive values of different methods of specimens collection in diagnosing pulmonary TB.

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>PPV</th>
<th>NPV</th>
<th>Accuracy</th>
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<tbody>
<tr>
<td>SI</td>
<td>80</td>
<td>100</td>
<td>100</td>
<td>50</td>
<td>83</td>
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<tr>
<td>Bronchial brushing</td>
<td>92</td>
<td>100</td>
<td>100</td>
<td>71</td>
<td>93</td>
</tr>
<tr>
<td>Bronchial washing</td>
<td>92</td>
<td>100</td>
<td>100</td>
<td>71</td>
<td>83</td>
</tr>
<tr>
<td>Post -bronchoscopic sputum</td>
<td>80</td>
<td>100</td>
<td>100</td>
<td>50</td>
<td>93</td>
</tr>
</tbody>
</table>

PPV: Positive predictive value. NPV: Negative predictive value
Table (4): Comparison between results of SI samples according to their sequence using ZN

<table>
<thead>
<tr>
<th>No of (SI) sample</th>
<th>+ve ZN</th>
<th>-ve ZN</th>
<th>Total</th>
<th>False – ve ZN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>First</td>
<td>10</td>
<td>33.3</td>
<td>20</td>
<td>66.7</td>
</tr>
<tr>
<td>Second</td>
<td>15</td>
<td>50</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Third</td>
<td>19</td>
<td>63.7</td>
<td>11</td>
<td>33.3</td>
</tr>
<tr>
<td>All</td>
<td>20</td>
<td>66.7</td>
<td>10</td>
<td>36.3</td>
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</table>

Table (5): Results of LJ media using SI and bronchial washing

<table>
<thead>
<tr>
<th>LJ media</th>
<th>+ve TB</th>
<th>-ve TB</th>
<th>Total</th>
<th>Z-test</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>22</td>
<td>73.3</td>
<td>8</td>
<td>26.7</td>
<td>30</td>
</tr>
<tr>
<td>Bronchial washing</td>
<td>25</td>
<td>83.3</td>
<td>5</td>
<td>16.7</td>
<td>30</td>
</tr>
</tbody>
</table>

Table (6): Sputum induction versus bronchial washing

<table>
<thead>
<tr>
<th>SI versus bronchial washing</th>
<th>Positive</th>
<th>Negative</th>
<th>X²</th>
<th>P. value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>Z-N</td>
<td>SI</td>
<td>20</td>
<td>66.7</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>bronchial washing</td>
<td>23</td>
<td>73.3</td>
<td>7</td>
</tr>
<tr>
<td>L-J</td>
<td>SI</td>
<td>22</td>
<td>73.3</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>bronchial washing</td>
<td>25</td>
<td>83.3</td>
<td>5</td>
</tr>
</tbody>
</table>

N.S: Non-significant (P> 0.05).

Table (7): Comparison between ZN versus LJ media using SI and Bronchial washing

<table>
<thead>
<tr>
<th>ZN versus LJ media</th>
<th>+ve TB</th>
<th>-ve TB</th>
<th>X²</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>SI</td>
<td>ZN</td>
<td>20</td>
<td>66.7</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>LJ</td>
<td>22</td>
<td>73.3</td>
<td>8</td>
</tr>
<tr>
<td>Bronchial washing</td>
<td>ZN</td>
<td>23</td>
<td>76.7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>LJ</td>
<td>25</td>
<td>83.3</td>
<td>5</td>
</tr>
</tbody>
</table>

Table (8): Comparison between different samples

<table>
<thead>
<tr>
<th></th>
<th>+ve TB</th>
<th>-ve TB</th>
<th>X²</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
<td>No</td>
<td>%</td>
</tr>
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<td>Bronchial washing</td>
<td>23</td>
<td>76.7</td>
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<td>20</td>
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</tr>
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<td>SI</td>
<td>20</td>
<td>66.7</td>
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</tr>
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<td>23</td>
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<td>7</td>
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</tr>
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</table>

DISCUSSION

Of the several components of TB control program, early case finding remains the cornerstone for an effective control and would also prevent the transmission of infection and disease.

Many new diagnostic tools have been developed recently for the diagnosis of pulmonary TB, however, their use is limited to the developed countries because of their cost and technical requirements. Detection and isolation of *M. tuberculosis* remains the gold standard (15). Although tuberculin test does not discriminate between active, past or...
BCG vaccination, it provides support to the diagnosis of active TB when other evidences point in that direction.\(^{(16)}\)

The present work showed that tuberculin skin test had 80% sensitivity, 80% specificity and 95.2% PPV in diagnosing pulmonary TB, in the studied group.

**Duchin et al,\(^{(17)}\)** reported a high specificity (98%) and **Kanaya et al,\(^{(18)}\)** found high PPV of tuberculin test (95%) among their studied groups of patients. They concluded that it is an important predictor of TB since the immunological response to tuberculin test is determined by a much lower number of TB organisms that exist even in the smear negative TB.

**Holden et al,\(^{(19)}\)** explained the false negative results among tuberculous patients by the poor nutrition, bad general health and overwhelming acute illness leading to immune suppression of the delayed type hypersensitivity. In addition to the previous explanations, the false negative results found in the present study, may be due to the prevalence of DM (40%).

On the other hand, **Agrawl,\(^{(20)}\)** stated tuberculin test is losing its utility as a diagnostic tool, with very low sensitivity and specificity especially in countries with high prevalence of tuberculosis and recommended that, to increase the specificity of the test, 15 mm or more induration must be considered as optimal cut off limit.

Using bronchial washing, 76.7% of the patients were diagnosed by Z.N staining. This percentage increased to 83.3% by LJ culturing. Bronchial washing Z.N sensitivity, specificity, PPV and NPV were 92%, 100%, 100% and 71% respectively.

**Sarkar et al,\(^{(21)}\) and Caminero et al,\(^{(22)}\)** reported a high diagnostic yield of bronchial washing. **Wongthim et al,\(^{(23)}\)** reported that it is markedly efficacious in making immediate diagnosis and discovering other diseases that mimick TB. The prevalence of cavitating lung lesions and the extensive radiological shadows may increase the yield of positivity.

**Abdel Hakim et al,\(^{(24)}\) So et al,\(^{(25)}\) and De Gracia et al,\(^{(26)}\)** reported low sensitivity of bronchial washing in subjects with suspected pulmonary TB. The variations in these reported data may be due to:-

1- Difference in the pathology of the included subjects: those with cavitary or endobronchial TB give more positive results (as the present study).

2- The difference in the methods of concentration, digestion and decontamination.

3- The difference in the amount of fluid used in bronchial washing as small volume in washing might reduce the number of obtained AFB. Moreover, The topical agents used to anesthetize the airway mucosa may be lethal to MTB affecting sensitivity of the procedure\(^{(27)}\).

Bronchial brushing sensitivity, specificity, PPV and NPP were similar to bronchial washing (92%, 100%, 100% and 71% respectively). These findings were supported by those of **Abdel Hakim et al,\(^{(28)}\) and Willcox et al,\(^{(29)}\)** On the other hand, **Danek and Bower,\(^{(30)}\)** reported that, the diagnostic yield of the bronchial brushing was only 20%. This low yield, may be due to inextensive lesions, brushing the bronchial mucosa not harboring AFB. The methods of AFB smearing, the use of concentrated methods and NALC-NaOH as a decontaminant agent in the present study, might have increased the yield of positivity.

In the present work, 20 patients (66.7%) were diagnosed by post- bronchoscopic sputum whose sensitivity, specificity, PPV and NPV were 80%, 100%, 100% and 50% respectively. Comparison between post-bronchoscopic sputum and bronchial washing showed no significant difference between both procedures. **Sarkar et al,\(^{(21)}\)** and **De gracia et al,\(^{(26)}\)** got similar results which could be explained by the use of small volume of washing (10 ml) which might decrease the yield of positivity of bronchial washing, while induced cough and expectoration from distal airways after FOB increases the yield of positivity of post-bronchoscopic sputum. **Chawla et al,\(^{(31)}\)** attributed their low values to the selected patients who had mainly dry cough and minimal lesions.

The present results showed no significant difference between sputum induction and bronchial washing in the diagnosis of pulmonary tuberculosis, whether by using Z-N or LJ medium culture. **Parry et al,\(^{(32)}\)** concluded that SI is an effective, low cost and simple technique for improving detection rate of TB as they found a diagnostic yield of 65.7%. These results are nearly comparable to those reported in the
present study. Even in children it is safe and more tolerated than gastric lavage(33).

Li et al,(34) and Kawada et al,(35) also reported similar findings, while others(36) found SI may provide the same if not better diagnostic yield compared with FOB. Higher values may be got by the use of higher concentration (3% hypertonic saline) that induces more secretions and sampling of the more distal airways. Even with normal lung parenchyma on chest X-ray Cond et al., (37) got remarkably high yield of induced sputum cultures (55%) in tuberculous pleural effusion cases providing implications for public health and clinical practice particularly in resource poor countries where invasive diagnostic procedures are less accessible. However, Shoaib et al,(38) studied the efficacy of SI technique, emphasized on the results reported by Merrick et al,(39) and concluded that SI does not seem to increase the diagnostic yield of sputum in patients who are already expectorating.

In all the previous studies(38,39) one induced sputum sample was investigated, which increases the yield of false negative results. Also, only patients with dry cough were exposed to SI but not smear negative spontaneously expectorating patients, a fact which might miss a large number of patients with productive cough that might give positive results with SI.

The third induced sputum sample, was the most sensitive in detecting AFB as revealed from this work.

Al-Zahrani et al,(40) Me Williams et al,(41) Cassscina et al,(42) Harvell et al,(43) agreed with these results and showed that multiple tests improve the diagnostic yield of SI. They reported that the cumulative yield from smear and culture was 64% and 70% respectively for one sample, 81% and 91% for two samples and 91% and 99% for the three samples.

On the other hand, Craft et al,(44) and Mathew et al,(45) diagnosed 89.5% of their studied cases by the first sample with only 0.2% increase on the second and 0.2% increase in the third sample. They recommended that, there is no need for the third sputum sample.

No significant difference was found between Z.N staining and L.J culturing using either SI or bronchial washing. Considering bronchial wash L-J culture as the gold standard, sensitivity, specificity and PPV of sputum induction Z.N were 80%, 100%, and 100% respectively. Christie and Callihan,(46) reported nearly similar specificity and sensitivity of Z.N staining, but Levy et al.(47) and Lobue et al (48) reported a very low sensitivity of Z.N staining. Also, from Egypt low ZN smear sensitivities 40% (6) and 47.4%(2) were previously reported. In the present study, the yields of LJ cultures were high (83.3%) compared with previous works.

The difference in sensitivities between the previous studies(47,48) and the present one may be due to the use of spontaneously expectorated sputum by the previous studies as SI increases the yield of sputum expelled from the distal airways leading to increased number of AFB. Specimens collection, smear preparation and staining technique might influence the outcome too.

Conclusion

There is no significant difference between sputum induction and fiberoptic bronchoscopy. On account of its non invasive character, its simplicity and its cost effectiveness, sputum induction by inhalation of an aerosole of hypertonic saline established itself as a technique of choice in the investigation of bronchial secretions in patients whose sputum samples were negative for AFB or who can not expectorate sputum. Clinical implication: Sputum induction must be done to every patient with clinical and radiological suspection of pulmonary tuberculosis who cannot expectorate sputum or their sputum samples were negative for AFB. Fiberoptic bronchoscopy should be postponed until three induced sputum samples proved to be negative for AFB.

REFERENCES


3-General directorate for chest disease. Tuberculosis Control guide. National


الملخص العربي
مقارنة البساق المستحدث بالمنظر الليفي الضوئي في تشخيص الدرن الرئوي

عمرو درويش، أحمد علي، وفاء زهران، نوران عزب، محمد أغا

أقسام الصدر وال mikrobiological* كليّة الطب - جامعة المنوفية

بعد الدرن الرئوي من أخطر الأمراض التي تهدى العالم رغم وجود طرق تشخيص متعددة إلا أن معظم هذه الطرق تعتمد على وجود الميكرب في بساق المريض ومن هنا توجد صعوبة في التشخيص عند عدم مقدرة المريض على إخراج البساق كما في حالات الكحة المفتوحة مثلا في مثل هذه الحالات يتم التشخيص باستخدام المنظر الليفي الضوئي وهي طريقة صعبة باهثة للكشف وقد كان الهدف من هذه الدراسة هو تقييم دور البساق المستحدث باستخدام محلل ملحي على التركيز في تشخيص حالات الدرن الرئوي، ومقارنة هذه الدور التشخيصي بالمنظر الليفي الضوئي. وقد تمت هذه الدراسة في قسم الصدر بمستشفى جامعة المنوفية على ثلاثين مريضاً تتراوح أعمارهم بين 20-68 عاماً تظهر عليهم علامات الدرن الرئوي إكلينيكياً وباشر الصدر العادية بينما كانت نتائج فحص البساق سلبية. تم عمل اختبار توبيركليت لجميع الحالات التي أشتبهت فيها. تم جمع عينات بصاق مستحدث بعد استخدام محلل ملحي 3% لمدة ثلاثة أيام متتالية.

كما تم جمع عينات من نفس المرضى بواسطة المنظر الليفي الضوئي، وهي عبارة عن غسول شعبي ومسحة شعبية كما تم تجميع بصاق ما بعد استخدام المنظار. فحصت هذه العينات بدراسة صبغة الزيل نيلسون كما زرعت على وسط ليشتين جنس (المستش). نتائج: كان اختيار التوبيكليت إيجابياً في واحده وعشرين حالة وتشخيص الدرن الرئوي عند عشرين منهم فقط بينما كان سلبياً في نصف حالات من بينهم سبع حالات درن (سلبية شائعة). أكمل الدراسة وجود خمس عشرين حالة درن رئوي أظهر فحص الحبر البدري وجود 34 حالة (78.7%) طبقاً لفحص زيل نيلسون ارتفعت إلى 80% (34 حالة). 34 حالة (78.7%) بعد ظهور نتائج المزارع

دراسة القدة التشخيصية للبساق المستحدث في حالات الدرن الرئوي وجد أنها 79.7% باستخدام صبغة زيل نيلسون ارتفعت باستخدام المزرعة إلى 82.3%. وبهذا فقد أثبتت الدراسة قرب القدة التشخيصية للبساق المستحدث بالمنظر الليفي إلّا أن هناك اختلاف ذو دلالة إحصائية بين نتائج البساق المستحدث وآلي من الطرق الثلاثة المستخدمة بواسطة المنظر الليفي.

الخلاصة:
أظهرت طريقة البساق المستحدث بمحلول ملحي على التركيز قدرة تشخيصية للدرن الرئوي لا تقل كفاءة عن قدرة المنظر الليفي الضوئي ربما تميزت عنها لسهولتها وقلة تكلفتها ودورة تطورها.