Dissertation on

SPECTRUM OF PLEUROPULMONARY INFECTIONS IN DIABETES MELLITUS

Submitted for

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BRANCH – XVII
TUBERCULOSIS & RESPIRATORY DISEASES

Institute of Thoracic Medicine
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Certificate

This is to certify that the dissertation "SPECTRUM OF PLEUROPULMONARY INFECTIONS IN DIABETES MELLITUS" is the bonafide original work of Dr. G. Srividhya in Partial fulfillment for M.D. BRANCH-XVII (T.B. AND RESPIRATORY DISEASES) EXAMINATION of The TamilNadu Dr. M.G.R. University to be held in MARCH 2008. The Period of study was from January 2006 to June 2007.

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Last but not the least, I thank all my patients for their cooperation, without whom this study would not have been possible.

DECLARATION

I Dr. G. SRIVIDHYA, declare that dissertation titled "**SPECTRUM OF PLEUROPULMONARY INFECTIONS IN DIABETES MELLITUS"** is a bonafide work done by me at Institute of Thoracic Medicine, Chetpet and Department of Thoracic Medicine, Madras Medical College & Govt. General Hospital, Chennai – 3 under the guidance of my Professor Dr. D. RANGANATHAN, M.D., (T.B. & C.D).,D.T.C.D.,Dip.N.B.

This Dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University towards partial fulfillment of requirement for the award of **M.D. Degree Branch – XVII (T.B. AND RESPIRATORY DISEASES).**

Place: Chennai
Date: (Dr. G. Srividhya)

CONTENTS

INTRODUCTION

INTRODUCTION

Diabetes and Pleuropulmonary Infections – A tale of two troubles.

DM is a chronic metabolic disorder seen in 5 to 10 % of the elderly population (1) .At the turn of the century many diabetic patients died of overwhelming infections. The introduction of insulin dramatically altered this situation and today non-communicable diseases are the major cause of death in diabetic patients. However infections in diabetics still poses a great challenge to physicians. It is a wake up call for all Clinicians and researchers to gear up to meet the challenge of the *brewing double trouble*.

Clinicians have generally believed that diabetics are more susceptible to infections and that infections are generally more severe in diabetics than they are in non-diabetics. Pulmonary infections (including PTB as well as other bacterial pneumonia) accounts for about 31% of infections in DM (2). Infections continue to be an important cause of concern in diabetics especially in developing countries like India and there has been a scarcity of controlled studies (3) that have conclusively shown that certain infections are more common in diabetics as compared to non-diabetics. We conducted a prospective study to analyse the spectrum of pleuropulmonary infections in Diabetes Mellitus.

AIM OF THE STUDY

AIM

The aim of our study is to analyse the clinical, radiological and microbiological aspects of Pleuropulmonary Infections in Diabetes Mellitus.

STUDY DESIGN:

Prospective study.

This study was examined and approved by the Ethical Committee of the institution.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Diabetes is one of the oldest diseases known to mankind. The eber papyrus of 1500BC mentions its symptoms and suggests treatment. In the same way infections related to diabetes are also known for long. The fateful association of diabetes mellitus and tuberculosis has been known for nearly one thousand years. At the turn of the century many diabetic patients still represent an important issue. Infection tends to occur at greater frequency and severity in diabetic patients than in non-diabetic. The occurrence of infection in a diabetic patient perpetuates a vicious cycle in which infection results in uncontrolled hyperglycemia which in turn causes further aggravation of infections.

Diabetics are more prone for infections as compared to normal. Uncontrolled diabetics rapidly promotes infection. There is a typical association of infection with diabetes, as sugar is a good media for rapid and abundant growth of organisms and at the same time infection itself distorts the blood sugar levels and may precipitate Keto acidosis. Such infections are responsible for complications and morbidity more frequently than would be anticipated in normal individuals. However now-a-days due

to improvement in the greater wealth and better understating of diabetes and with the development of most effective diagnostic techniques, earlier intervention with newer human insulins as well as availability of broad spectrum antibiotics with better tolerability have made the results more favourable and hence the death rates due to infections had gone down from 17.6% in pre-insulin era to 8.5% in insulin era. Let us hope still some better data will come out in recent future.

HYPERGLYCEMIA AND IMMUNE SYSTEM:

It is said in diabetics there are certain factors, which play part in this direction. Increased susceptibility in Type 1 diabetic do play role. The impairment of wide range of functions in neutrophils and macrophages including chemotaxis and adherence ,phagocytosis and intracellular killing of microorganisms is brought by hyperglycemia. In diabetes the movement of phagocytic cells may be generally impaired.

The W.H.O. has included diabetes in its classification of secondary immunodeficiency diseases. The development of secondary immunodeficiency seems to be alterations involving at generally including polymorphonuclear granulocytes and/or lymphocytic subsets activity.

Polymorphonuclear granulocytes represent the host's first defense barrier against bacterial agents. Alteration in chemotaxis, phagocytosis , immunoglobulin production and complement functions do occur in diabetic patients (11). Polymorphonuclear granulocytes cells from diabetics have a reduced chemotaxis especially when the diabetes is poorly controlled. There are two stages of phagocytosis adhesion and ingestion of microorganisms into intracytoplasmic vacuole. An increase in sialidase enzyme secretion together with corresponding reduction in cell membrane sialic acid may pay part along with defective Lactin receptors losing their capacity to recognize target and fail to initiate phagocytosis. The critical step of intracellular killing is mediated by the release of toxic free radicals, super oxides and hydrogen peroxide. This "respiratory bust" which is impaired in diabetics correlates with intracellular killing (24). This whole process is dependent on NADPH.

The NADPH is normally generated by the metabolism of glucose through HMP shunt and in diabetics more glucose enters the phagocytes and is metabolized by polyol pathway. Aldose reductase, the rate limiting enzyme of this process requires NADPH and this is consumed when flux through polyol pathway increase. This competition for NADPH is thought to account for the reduction in the respiratory bust and in intracellular killing.

The metabolic disturbances associated with diabetes are probably important in impairing the function of polymorphonuclear cells. Once phagosome and lysosome function has taken place, killing is carried out by the lysosmal enzymes. A decrease in the killing capacity of polymorphonuclear granulocytes associated with high blood sugar may come to normalization within 48 hours after correction of blood sugar levels.

Several immunoglobulin levels IG G and IG A have been reported to be reduced in diabetics as compared to normal. As well as significant reduction in the quantity and functional activity of complement component may occur in diabetic patients. Above all these local factors like underlying susceptibility to infection, vascular disease, nerve damage and increase in blood sugar may aggravate the process. This may call upon decrease circulation, hypoxia and reduction in absorption of antibiotics and proliferation of bacteria.

In type I diabetes or IDDM, genetic predisposition to infections also plays a part. Along with all above factors, which are abnormalities of phagocyte functions mobilization & chemotaxis, adherence, phagocytosis, and intracellular killing with bactericidal activities, micro vascular circulation abnormality may result in decreased tissue perfusion. Hyperglycemia per say reduces oxidative killing capacity because of

increased glucose metabolism through polyol pathway depleting NADPH, which is necessary for generation of superoxide free radicals.

In type 1 DM, there is alteration in some lymphocytes subpopulations, a reduction in T lymphocytes and specifically in the number of CD4 phenotype (25) and reduction in CD4/CD8 ratio, serum immunoglobulin levels IgG and IgA have been reported to be reduced in diabetics compared to normal. As well as significant reduction in the quantity and functional activity of complements may occur in diabetics patients. An underlying susceptibility of target tissues due to hyperglycemia, vascular disease and nerve damage is proved with the relative tissue hypoxia may cause proneness to infections. A reduction in antibiotic absorption due to microangiopathy may lead to persistence of infections. About 25% of IDDM subject have this.

CHANGES IN MICROCIRCULATION:

The presence of healthy microcirculation is essential to certain infectious insults. Alteration in the function of capillary endothelium, the rigidity of red blood corpuscles and changes in the oxygen dissociation curve that occur as a result of chronic hyperglycemia are factors which affect the host's ability to combat infections. It is therefore no surprise that patients with longstanding diabetes with complications are at a much greater risk of infections than non-diabetics or diabetes without complications. The reduced oxygen supply to tissue as a result of micro vascular changes predisposes

them to infections by anaerobic microorganisms which grow best under such conditions (26,27).

OTHER REASONS:

Diabetic gastro paresis may increase the risk of aspiration (28). Some medications may impair host defence: Calcium channel blockers may impair phagocyte function, whereas digoxin may decrease clearance of pneumococci from the lower respiratory tree. Abnormalities in ciliary motility are also important. Pneumonia, PT, fungal infections and parasitic infections have a different course in diabetics than in general population (24).

To sum up the list of defects in diabetics' immunologic make up and physiologic pulmonary functions are as follows: (30)

Immunologic abnormalities in diabetics.	**Pulmonary Anatomical & physiologic disturbances in diabetics.**
Abnormal chemotaxis, adherences phagocytosis and microbicidal function of polymorphonuclear leucocytes.	Diminished bronchial reactivity.
Decreases peripheral monocytes with impaired phagocytosis.	Reduced elastic recoil and lung volumes
Poor blast transformation of lymphocytes	Reduced diffusion capacity
Defective C3 opsonic function	Occult micro plugging of airways
	Reduced ventilatory response to hyperemia.

This is adapted from Infections in Diabetes mellitus. (31)

WHAT EFFECT INFECTION PRODUCES ON METABOLISM:(33)

The major cause of hyperglycemic crisis is infection. It is the most common cause for precipitation of ketocidosis in diabetics and it accounts for 30% of cases. Due to increased secretion of counter regulatory hormones such as glucagon, cortisol, GH and catecholamines, gluconeogenesis is stimulated and blood glucose levels are increased and insulin secretion is inhibited. This results in relative or absolute insulin deficiency. In NIDDM due to insulin resistance significant hyperglycemia may persist as glucose uptake in liver and skeletal muscles is impaired. The elevation of counter regulatory hormones should be dealt with immediately considering condition itself and infection too.

The underlying mechanism has still to be determined, but increases circulating cortisol concentrations and in certain cytokines, secreted by immune cells in response to infection, may contribute amongst the latter are the interleukins and TNF &, which impair insulin action by inhibiting the tyrosine kinase activity of the insulin receptor. Hence the requirement is to keep blood sugar near normal levels.

SPECIFIC INFECTIONS IN DIABETES MELLITUS:

Incidence of infections in DM: (2)

UTI	28.6%
TB	20.1%
Skin Infection	28.6%
Bacterial Pneumonia	10.4%
Foot infection	10.4%
URTI	8.4%
PUO	5.8%
Cholecystitis	3.2%
CSOM	1.3%
Others	9.1%

The above table is the summary of a retrospective study on incidence and pattern of infections in diabetes mellitus conducted by Department of Endocrinology, IMS Srinagar. From this study it is clearly evident that TB is the third most common infection in diabetics next to UTI and skin infection followed by Bacterial pneumonia.

BACTERIAL PNEUMONIA

Infections with increased frequency may be due to Staphylococcus aureus and gram-negative organism such as Klebsiella, E-coli, Enterobacter, Pseudomonas and Acinetobacter.

Infections with possibly increased morbidity and mortality may be due to Streptococci, Legionella, Viral infection. Viral infections in diabetic patients are often complicated with Bacterial Pneumonia.

Anaerobic bacteria may cause pneumonia as a result of esophageal disorders (motility) disorders & ciliary motility, impaired bronchial and bronchiolar reactivity (Clearance mechanism).

INFECTIONS WITH INCREASED FREQUENCY:

Staphylococcal Infection:

Staphylococcus is a major pathogen in the etiology of both community acquired and nosocomial pneumonia in diabetic patients. On the basis of a high nasal carriage rate, diabetics are though to be at an increased risk of staphylococcal pnemonia. Upto 30% of diabetics are nasal carriers of S.aureus as compared to 11% in normal individuals. (34) The rate of nasal carriage of S.aureus is directly related to HBAIC levels (35, 36). Pneumonia due to S. aureus may be either primary, following aspiration of organisms from upper airway, or secondary to hematogenous spread of distant infection. S.aureus pneumonia typically presents as an actue process with lobar or segmental consolidation, no clinical or radiographics features can distinguish from the other types of pneumonia. Diabetics are at a risk of developing complications of bacteremia in S. aureus pneumonia, with increase in mortality (36).

Gram Negative organisms:

GN aerobes cause approximately 10% - 20% of all community acquired pneumonic and 60 – 80% of all nosocomial pneumonia (37). In general, gram negative bacteria are acquired by the following three routes:

- Aspiration of the pathogen from the colonized pharynx
- Hematogenous spread of extrapulmonary infection (or)
- Acquisition via contaminated equipment such as contaminated nebuliser.

Although the latter two mechanisms are sometimes encountered, aspiration is the most known way of lung infection. The upper airway colonisation occurs within 24 – 48 hours of hospitalization even in normal individuals; lowest healthy individuals are resistant to upper airway colonization by GN aerobic bacteria (28). The predisposition of diabetics to the development of gram negative aerobic pneumonia is attributed to an increased rate of upper airway colonisation with these organisms (38). The ability of GNB to adhere to the upper respiratory epithelium is also increased in diabetic patients. Upon adherence, bacteria are aspirated into the lungs, where last defense may be further impaired by factors such as coexisting pulmonary edema and impaired phagocytosis. Retrograde colonization of the pharynx from the stomach may be an additional factor at medical intensive care units (39). The subsequent risk & aspiration is increased by diabetic gastroparesis. (40).

Pulmonary Infections With Increased Mortality and Morbidity:

Gram-positive cocci such as S.pneumonia are responsible for the majority of infections in diabetic patients, followed by agents such as H. influenza (41). Diabetics

may develop a more severe disease due to organisms such as S. Pneumonia, and have higher rates of hospitalization and development of complications such as bacteremia. Diabetes has been associated with a increased risk of recurrent bacterial pneumonia. (42). H. influenza is not more common in diabetics, although it may be more common in the elderly in whom type 2 diabetics is also prevalent (43)

Aerobic gram-negative organisms and staphylococcal infections typically are the most important causes of nosocomial pneumonia in diabetic patients. Furthermore, approximately 25% of nosocomial infections are polymicrobial. Bacterial pneumonia in diabetic individuals, especially when caused by Klebsiella and Staphylococcus, is assoiated with the more severe course of the disease and more frequent need of mechanical ventilatory support. (44)

Streptococcal Infection:

Although diabetics may have a slightly higher rate of carriage of group A streptococcus which can cause severe pneumonia it is unclear whether diabetes can be separated as a risk factor. Of all streptococcal infections, group B streptococcal is most severe micro organism in diabetic patients. Lung may be the portal of entry. Diabetes is

a risk factor for development of bacteremia in pneumococcal pneumonia resulting in mortality. (45).

Anaerobic Bacteria:

Aspiration of oropharyngeal contents, composed of anaerobic bacteria, frequently occurs in the normal host but rarely results in pneumonia in the presence of intact pulmonary clearance mechanisms. Although DM is not specifically identified as a risk factor for developing pulmonary infections, diabetic patients are probably at risk because of altered cough and clearance mechanisms, esophageal disorders and depressed mental status (hypoglycemic seizures), which are identified as risk factors for developing aspiration pneumonia. (46).

The most important complications of pneumonia in diabetics are pleural effusion, empyema (because of the increased risk of aspiration, esophageal disease, neurologic abnormalities) and bacteremia (klebsiella infection is the most common cause of septicemia and associated with a high incidence of metastatic infections), which increases the mortality twofold in diabetics (46).

PULMONARY TUBERCULOSIS:

The onset of lung tuberculosis is more common in diabetics than in general population. Lung TB is a common accompaniment of diabetes and the cause of insulin resistance and “brittleness”. The incidence of diabetes amongst PT patients was much higher compared to normal population. In some parts of the world with still endemic TB, a higher than expected proportion of patients with TB have diabetes. When persons with diabetes do not respond in spite of appropriate treatment, they should be screened for TB, as weakness, sweating and weight loss are common for both TB and diabetes. The presence of anorexia in a diabetic may point to associated TB (41).

Some important points about lung tuberculosis in diabetes:

- The development of lung TB is more common in diabetic individuals than in general population.
- The duration of diabetes has no effect on the occurrence of PT.
- The incidence of TB is increased in uncontrolled diabetics and in patients with severe diabetes requiring high doses of insulin.

- The problems in diabetics with lung TB include a severe form and more aggressive course of the disease, a higher tendency to destruction and cavitation, and more common resistance to ATT.(47)
- Atypical chest X-ray findings: lower lobe or multiple lobe involvement, higher incidence of cavitation, and high incidence of pleural effusion in diabetics than in non-diabetics.
- Complete resolution occurs in patients with HLA A1 and DR.
- In patients with HLA A2 & DR3, large caseous form of Tuberculosis is formed.

Probable reasons for high association of TB and diabetes:

- Hyperglycemia favours the growth, viability and propagation of tubercle bacilli.
- Disturbance of electrolyte balance and local tissue acidosis favour infection.
- Impaired phagocytosis and impaired cellular immunity in persons with diabetes allows for the spread of the disease over neutralizing antibodies in bronchial secretions.
- Lower resistance due to vascular damage to lung tissue.
- Disordered nutritional balance.

METHODOLOGY

MATERIALS AND METHODS

Known diabetic patients/cases recently diagnosed to have DM during the course of hospital stay who had features of pleuropulmonary infections clinically in the form of fever, cough, pleuritic chest pain with or without hemoptysis with radiological features supporting the same,between January 2006 to June 2007 were evaluated for inclusion in this study.

In all these patients, a detailed history was taken and a thorough clinical examination was done as well. These cases were then subjected to investigations after getting informed consent. Basic hematological and biochemical investigations included Complete Hemogram with Total count and Differential count, Fasting and Post Prandial Blood sugar, Blood Urea, Serum Creatinine, Serum Electrolytes and Liver function tests. In patients with impaired glucose tolerance, Oral glucose tolerance testing was done and the following criteria was used to diagnose diabetes mellitus.

Categories of Hyperglycemic according to various plasma glucose concentrations (12, 13,14)				
2 hr post load plasma glucose level	Fasting plasma glucose			
	Normal **a**	Impaired **a**	Diabetes	
	< 100mgldl	100-125mgldl	> 126mgldl	Not done
<140mgldl (7.8mmo1/L)	Normal **b**	IFG	Diabetes	"Normal"
140-199 mgldl (7.8-11.0mmo1/L)	IGT **b**	IFG/IGT **c**	Diabetes	IGT
> 200mgldl (> 11.1mmo1L)	Diabetes **b**	Diabetes **b**	Diabetes	Diabetes
Not done	"Normal"	IFG	Diabetes	Unknown

a. The 1987 ADA and 1999 wHO recommendations for fasting plasma glucose valves were as follows: normal 110mgldl; impaired 110-125mgldl; The values listed in the table reflect the most recent 2003 ADA expert committee recommendations.

b. These categories are identifiable only if OGTT is performed

c. This category is currently classified by ADA recommendations as IFG and IGT and by WHO as IGT.

Patients in whom diabetes mellitus was confirmed by the above tests ,were included in this study and subjected to appropriate investigations as follows:

From all such patients, the following samples were submitted for microbial analysis.

a) Sputum

b) Blood

c) Pleural fluid (if present)

d) Bronchial wash (in selected cases)

Cases with clinical, radiological features, sputum for AFB analysis negative for PT were evaluated for pyogenic infections. Blood, sputum, pleural fluid (if present) were submitted for gram stain, NT culture, fungal smear and fungal culture and these patients were started on appropriate parenteral antibiotics. They were followed up with chest radiographs. Patients not responding to antibiotics and those in whom the above samples did not contribute to diagnosis were subjected to Bronchoscopic assessment after computerized tomogram evaluation of the chest. Bronchial wash was taken from the involved segments as assessed by CT chest and sent for detailed microbial analysis which included AFB smear, Gram stain, NT culture, Fungal smear and Fungal culture and antibiotic therapy was reinstituted as per the results. In patients with features suggestive of pneumonia , severity was assessed using CURB 65 score.

CURB 65 SCORING SYSTEM:

Confusion

Blood Urea Nitrogen > 20 MG/DL

Respiratory Rate > 20 / min

Low Blood Pressure SBP < 90 MM HG

Age > 65 yrs

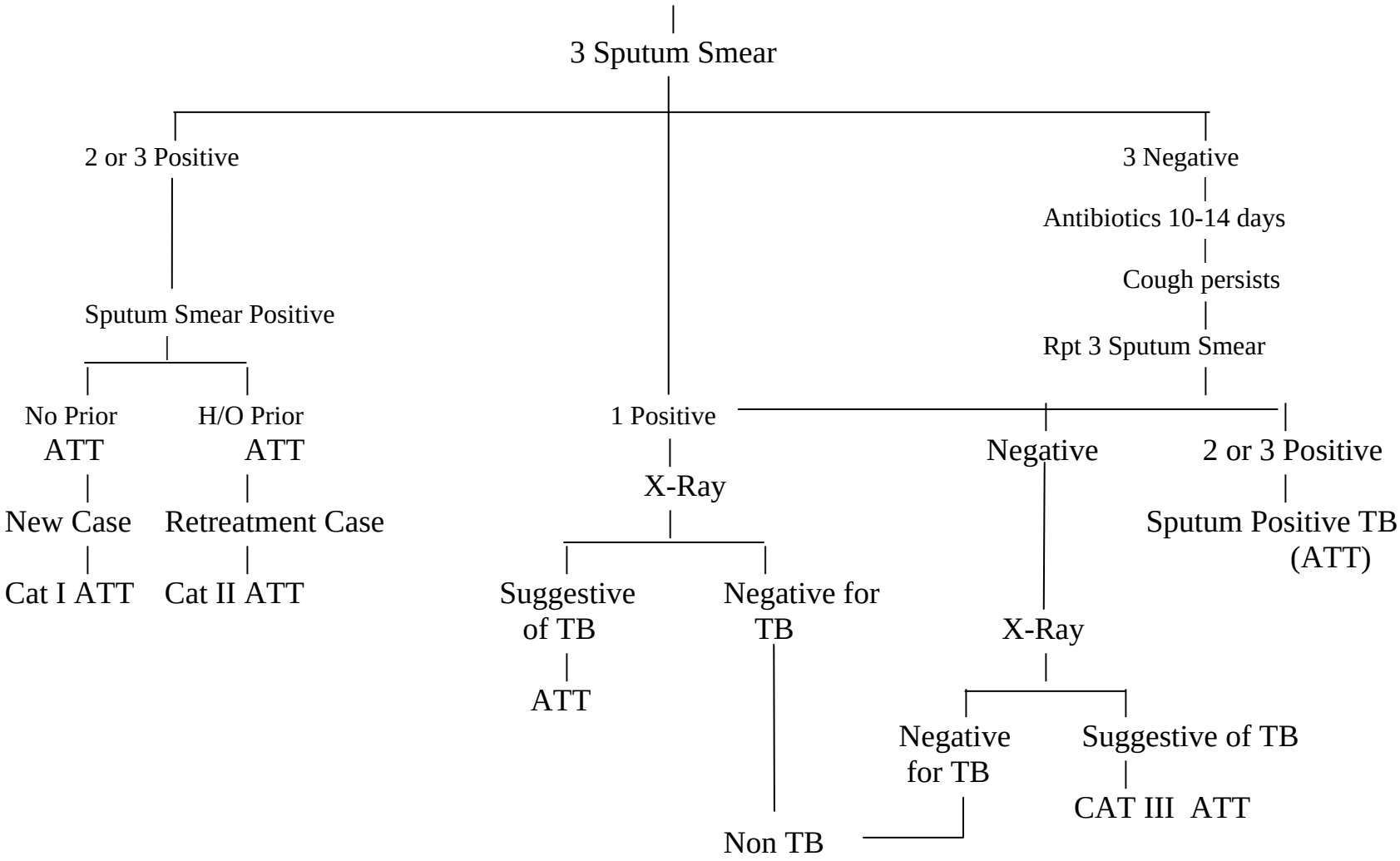
RISK STRATIFICATION USING CURB 65 SCORE:(56)

GROUP 1: SCORE 0-1: LOW MORTALITY (1.5%)

GROUP 2: SCORE 2: INTERMEDIATE MORTALITY (9.2%)

GROUP 3:SCORE 3 OR MORE: HIGH MORTALITY (22%)

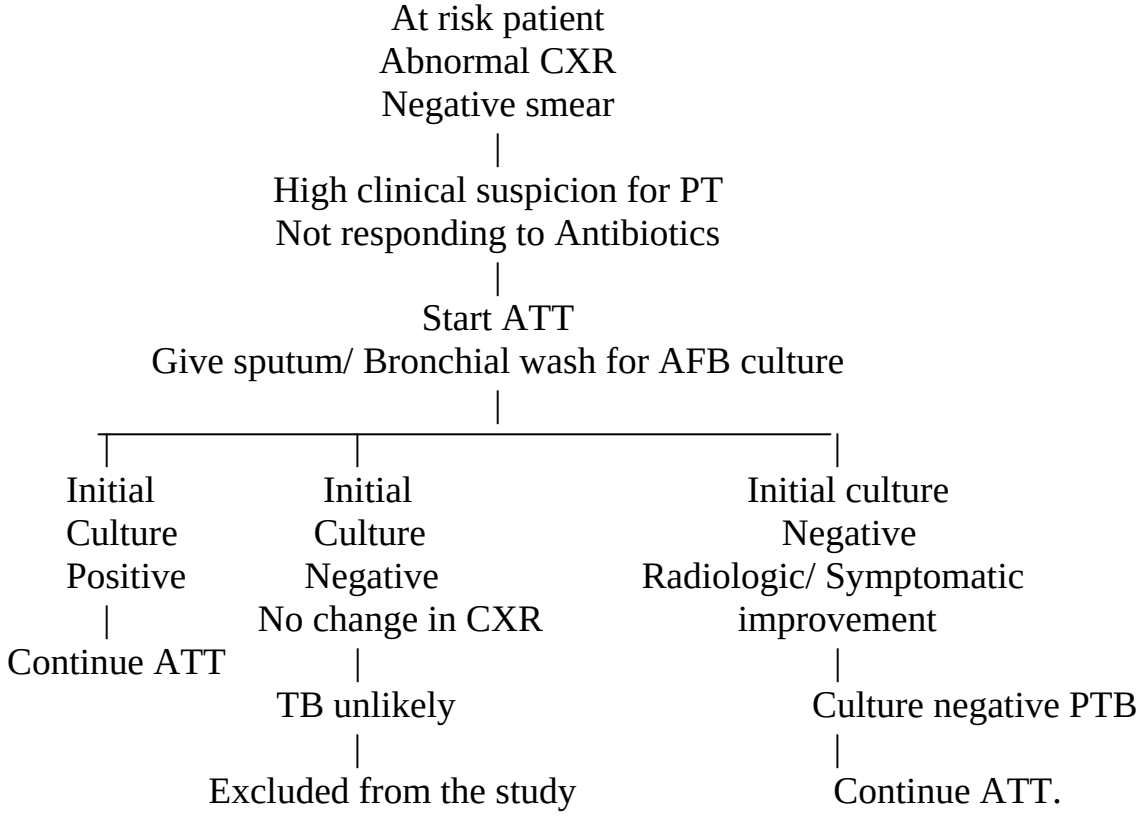
The following diagnostic algorithm was followed for diagnosis of Pulmonary TB.(15)



Sputum smear negative cases whose clinical and radiological features were not definitely conclusive of PT were subjected for Bronchoscopy and Bronchial wash was sent for AFB smears, AFB culture, Gram stain, NT culture, fungal smear and culture. After ruling out pyogenic/ fungal infections, these patients were started an ATT and followed up after 2 months with repeat chest radiographs and Bronchial wash AFB culture results. Those patients with clinical/ radiological improvement at the end of 2 months were continued on the same line of management. Those in whom these was no adequate response to ATT / Bronchial wash AFB culture Negative were excluded from this study, as there was a high possibility of non-infections causes including malignancy in such cases.

TREATMENT ALGORITHM FOR POSSIBLE TB INFECTION (49)

(SPUTUM FOR AFB SMEAR NEGATIVE)



This section deals with the method of evaluation of pleural diseases. Thoracentesis was done in all patients with pleural effusion and pleural fluid biochemical, cytological, microbial analysis was done. Pleural biopsy was done in case of exudative pleural effusion wherein bacterial/ fungal infection was ruled out and after ruling out malignancy, these patients were started on ATT. Sputum AFB smear was done for cases of pyothorax with underlying parenchymal disease. If Sputum AFB/ pleural fluid AFB was positive then patient was started on ATT and ICD was done. In sputum /P1 fluid AFB negative cases, CT chest was done after ICD insertion. If the nature of the underlying parenchymal disease was in favour of Tuberculosis these patients were started on ATT and those with CT features suggestive of pyogenic infection (in the form of consolidation/ lung abscess) were started on parenteral antibiotics and followed up with serial chest radiographs.

EXCLUSION CRITERIA:

Patients with age < 15 yrs; secondary causes for hyperglycemia (like drug induced, pancreatic pathology, other endocrine disorders); other associated immunodeficiency states like retroviral disease, renal/ hepatic failure; patients on immunosuppressive drugs; diabetic patients with endobronchial mass lesion causing obstructive pneumonia/ lung abscess; patients with transudative pleural effusion were all excluded from this study.

results

Table 1: INCIDENCE OF PLEURO PULMONARY INFECTIONS IN DM

TYPES	NO. OF CASES OF NON TB INFECTIONS	NO. OF CASES OF TB	PERCENTAGE
Impaired Glucose Tolerance	-	5	5%
Type 1 DM	3	4	7%
Type 2 DM	40	54	88%
Total	43	63	100%

Majority of pleuropulmonary infections occurs in Type 2 DM accounting for about 88% (n=94) and only 7 cases out of 106 cases were Type 1 diabetics contributing to around 7%. Among patients with Tuberculosis ,8% had impaired glucose Tolerance(19).

Table 2: DISTRIBUTION OF PATIENTS BY TIME INTERVAL BETWEEN DIAGNOSIS OF DM & PLEUROPULMONARY INFECTIONS.

Time Interval between Diagnosis of DM and Pleuropulmonary Infections	**Number of Cases due to Non TB Infection**	**Number of Cases due to TB**	**Percentage**
Synchronous	15	25	38
< 1 yr.	8	13	20
1 – 5 yrs	10	15	23
6 – 10 yrs	8	7	14
> 10 yrs	2	3	5
Total	43	63	100

From this table it is evident that most of the pleuropulmonary infections occur within the first 5 years of diagnosis of diabetes mellitus, unlike microvascular complications which has a long latency period.

Table: 3 DISTRIBUTION OF CASES BY AGE AND SEX

Age in years	Non Tuberculous Infections		Percentage of NT Infections	Tuberculosis		Percentage of TB
	Male	Female		Male	female	
< 25 yrs.	2	1	3%	2	2	4%
25-34 yrs	1	1	2%	3	2	4%
35-44 yrs	9	7	15%	14	7	20%
45-54 yrs	10	6	15%	12	8	19%
55-64 yrs	2	2	4%	6	4	9%
> 65 yrs	1	1	2%	2	1	3%
Total	25	18	41%	39	24	59%

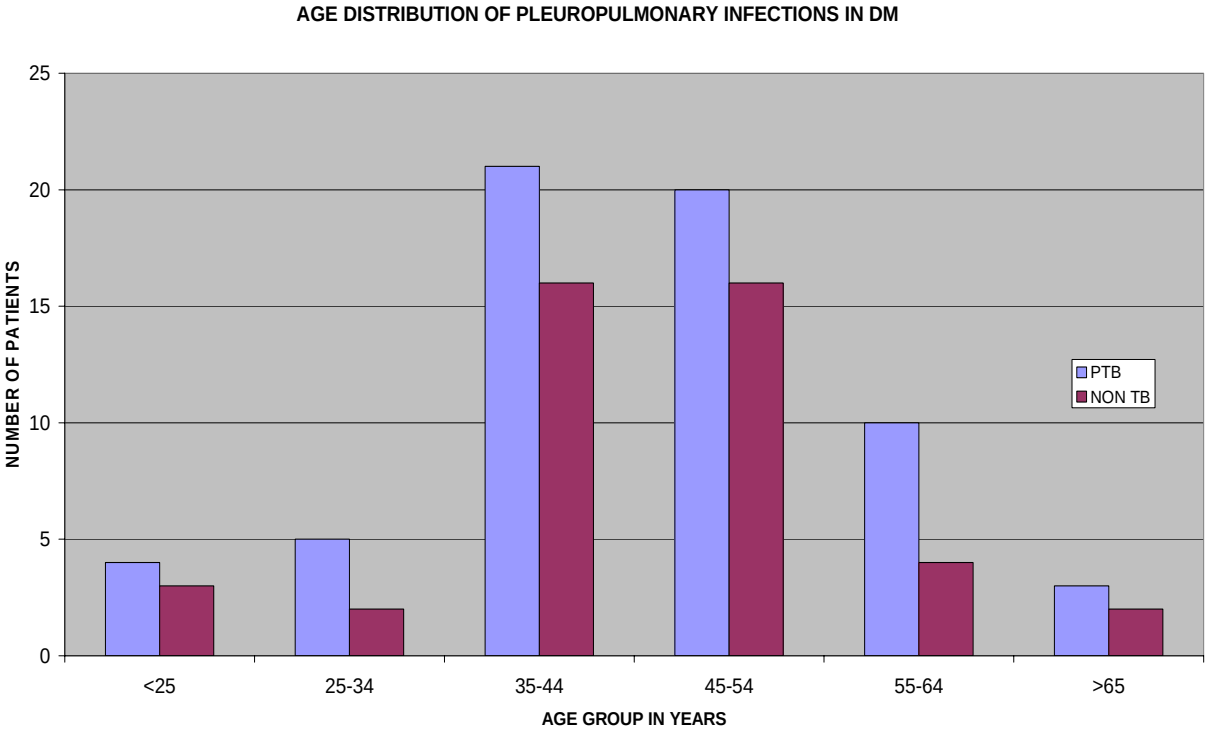
Tuberculosis:

Male: 39 (62%); Female: 24 (38%), Total: 63

Non Tuberculosis Infection:

Male: 25 (58%); Female: 18 (42%), Total: 43

Majority of these infections i.e. about 69% of cases are between 35 – 54 years(17) and there is a slight male preponderance with male: female ratio of 3:2.


AGE DISTRIBUTION OF PLEUROPULMONARY INFECTIONS IN DM
NUMBER OF PATIENTS
25
20
15
10
5
0
PTB
NON TB
<25
25-34
35-44
45-54
55-64
>65
AGE GROUP IN YEARS

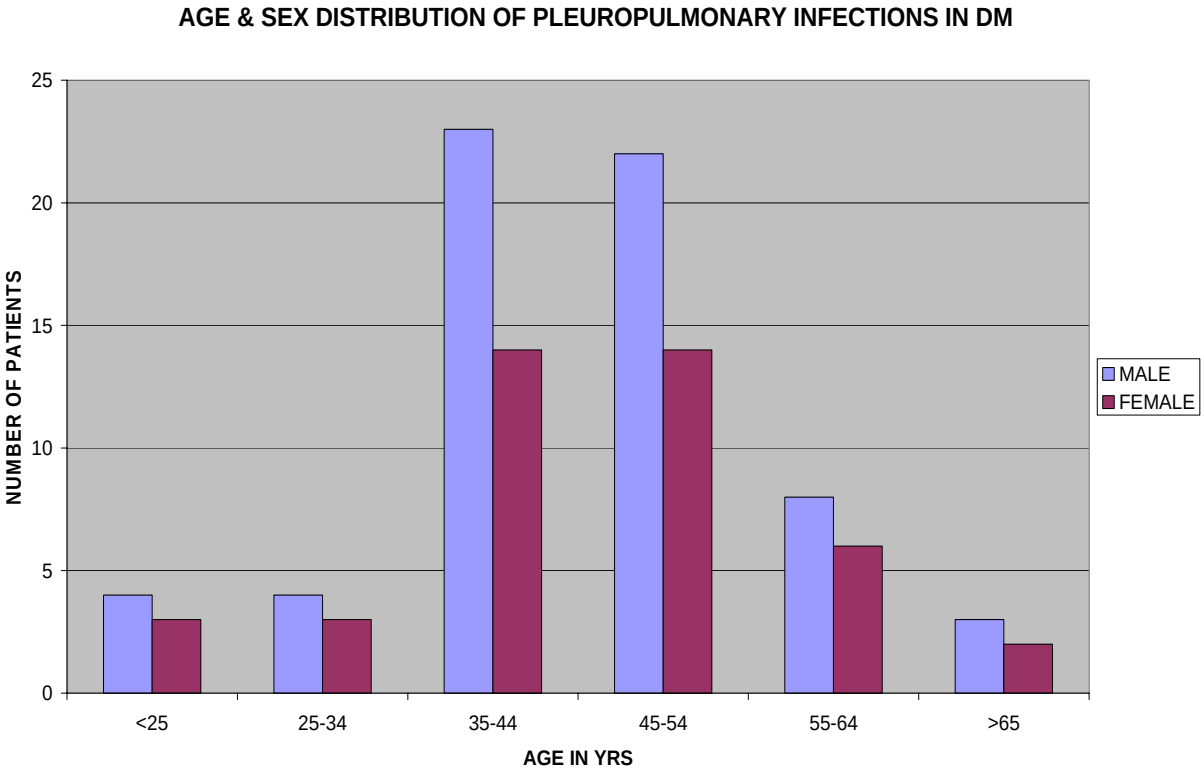
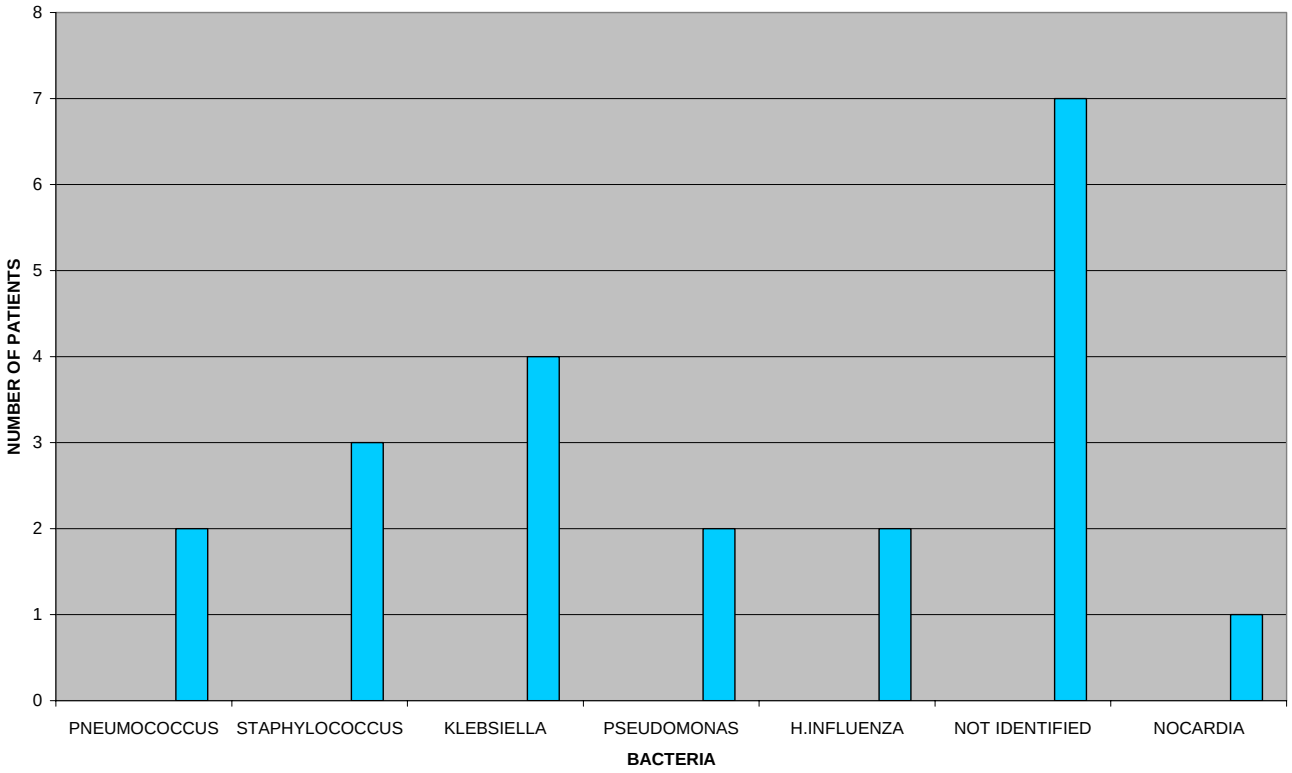

AGE & SEX DISTRIBUTION OF PLEUROPULMONARY INFECTIONS IN DM
NUMBER OF PATIENTS
25
20
15
10
5
0
<25
25-34
35-44
45-54
55-64
>65
AGE IN YRS
MALE
FEMALE

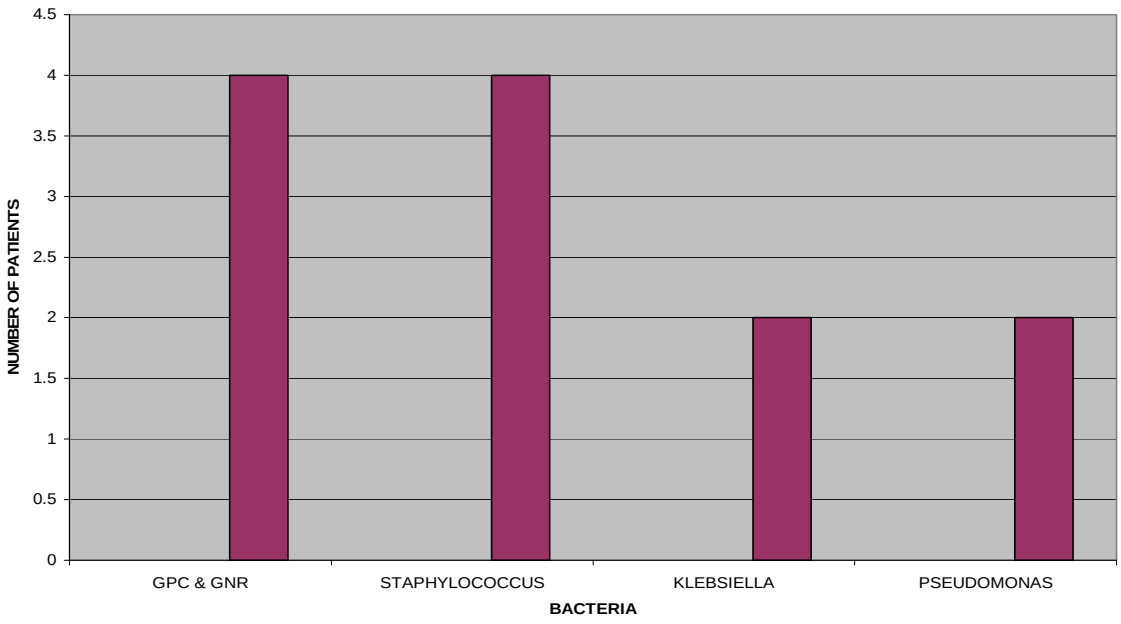
Table 4: ETIOLOGICAL CLASSIFICATION OF PLEUROPULMONARY INFECTIONS IN DIABETICS

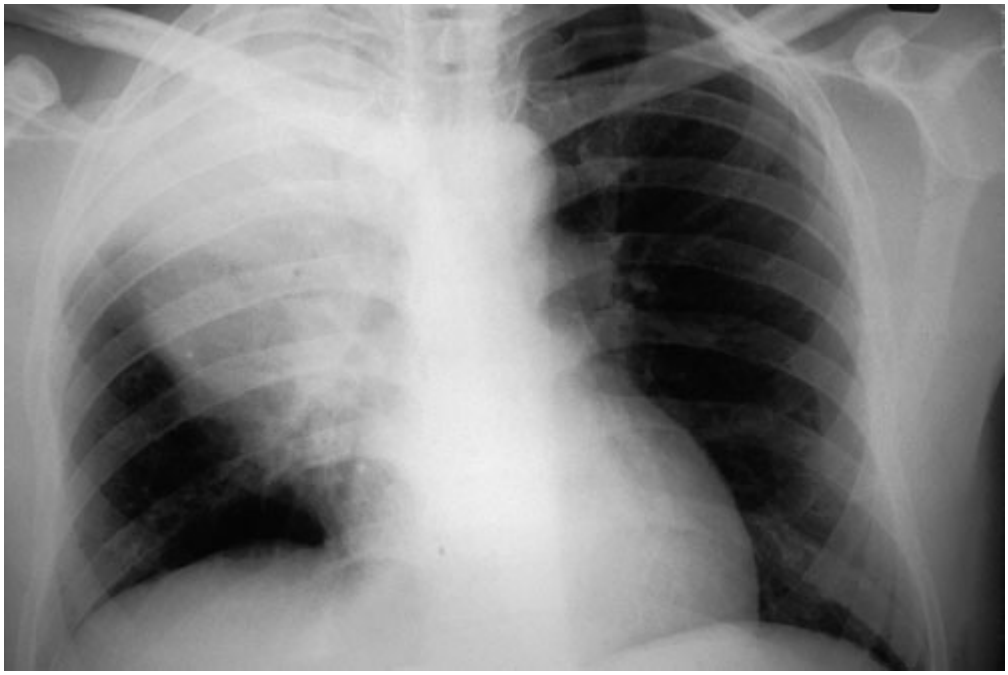
Etiology	Total Number of Cases	Percentage
Bacterial Infections	*40*	*38%*
Strep. Pneumonia	2(5%)	
Staph. Aureus	9(23%)	
H. Influenza	2(5%)	
Pseudomonas	8(20%)	
Klebsiella	7(17%)	
Nocardia	1(2%)	
GPC + GNR,MIXED	4(10%)	
Not Identified	7(18%)	
Protozoal	*3*	*3%*
Amebiasis	3	
Tuberculosis	*63*	*59%*
Pleural	5 (8%)	
Parenchymal	45 (71%)	
Pleural & Parenchymal	13 (21%)	

MICROBIAL ETIOLOGY OF PNEUMONIA IN DM

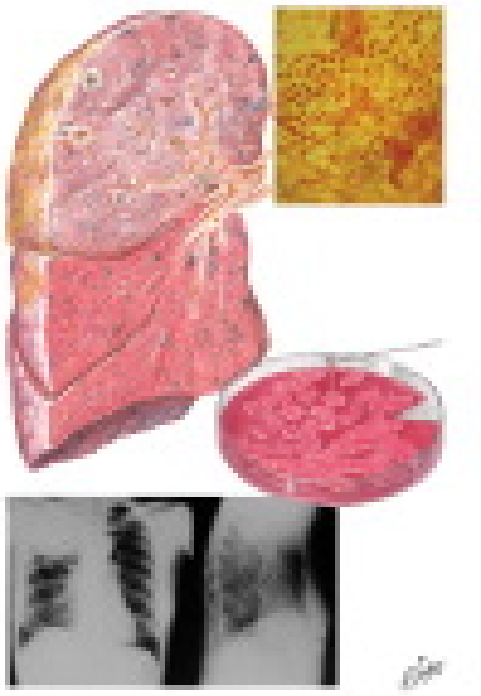


MICROBIAL ETIOLOGY OF LUNG ABSCESS

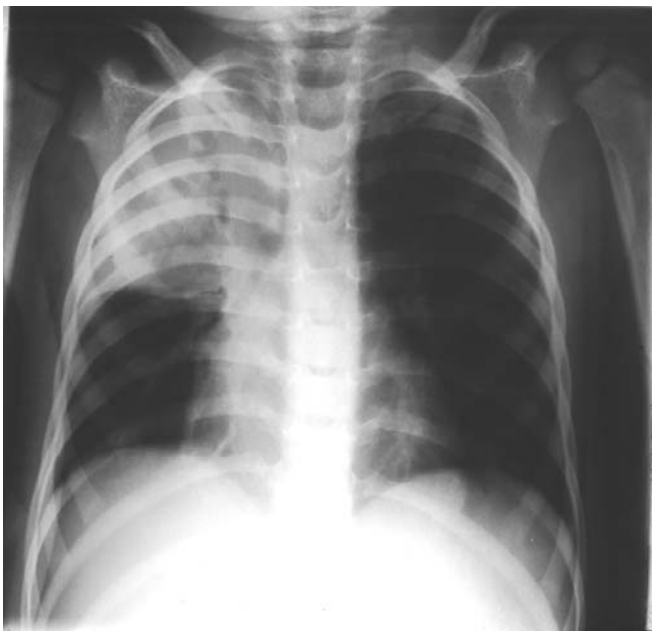




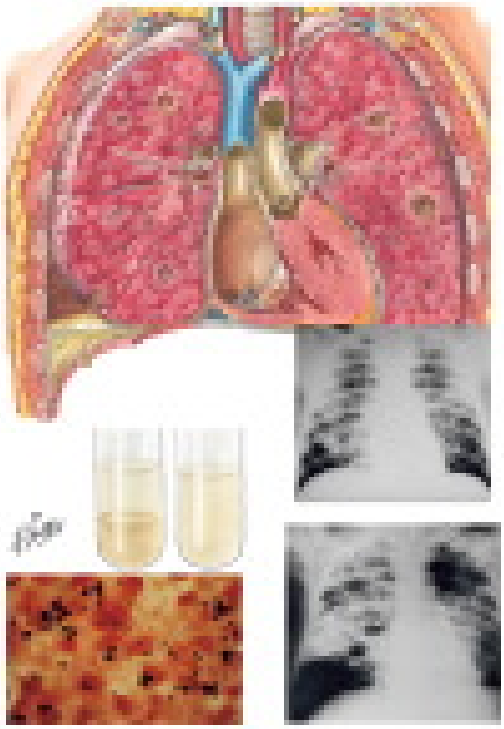
RIGHT U/L CONSOLIDATION



KLEBSIELLA PNEUMONIA



RIGHT U/L CAVITATING CONSOLIDATION



STAPHYLOCOCCAL PNEUMONIA

NOCARDIOSIS

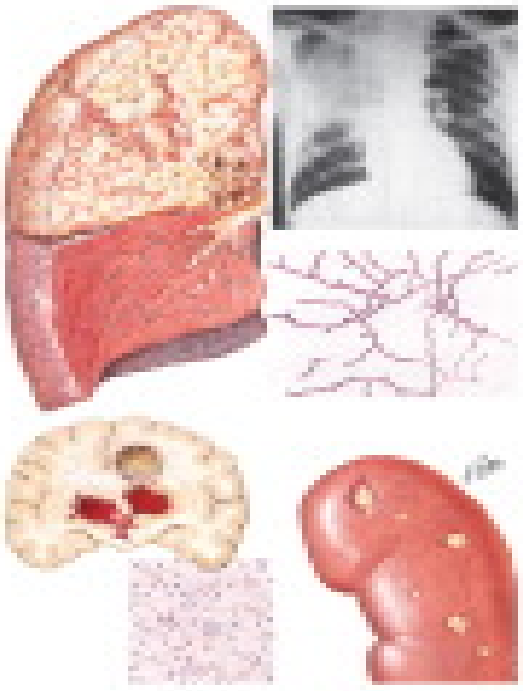
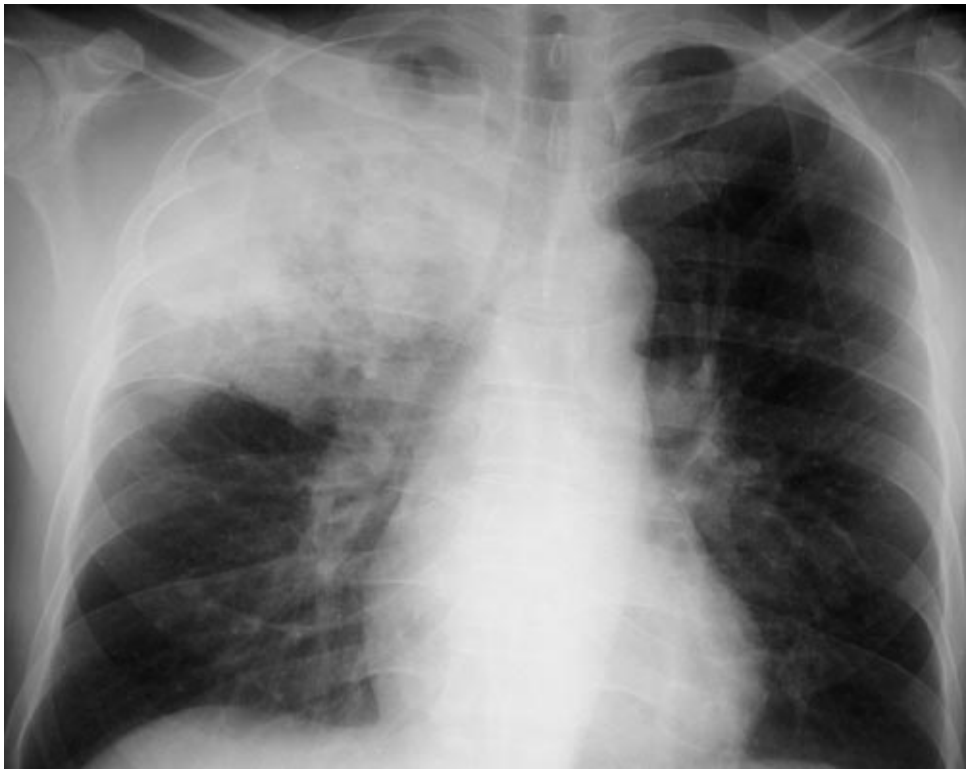


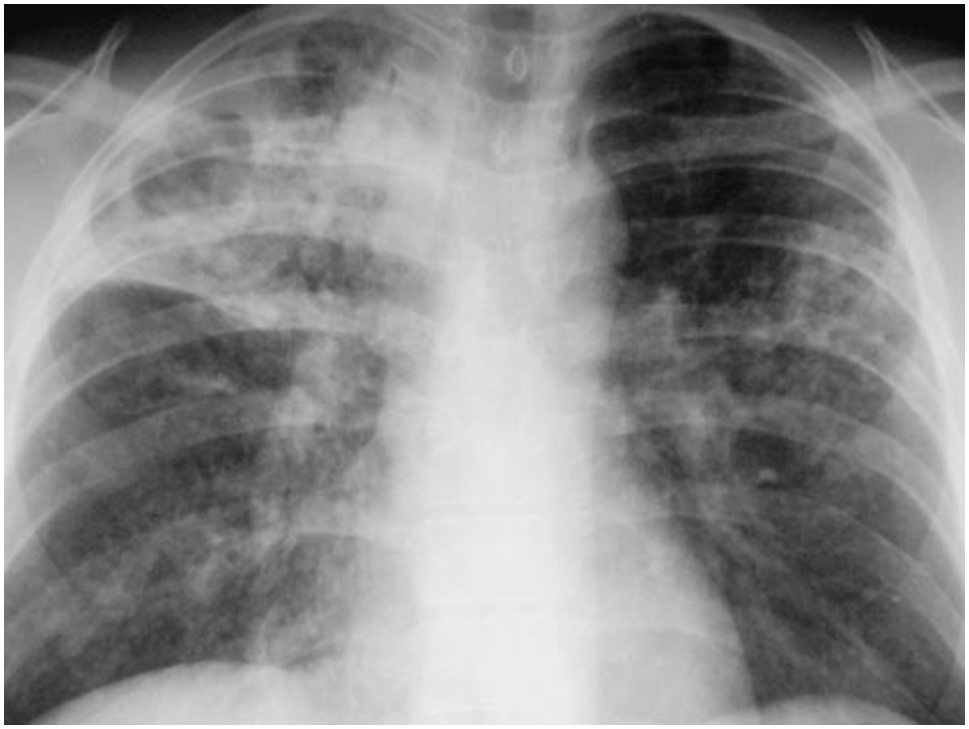
Table 5: RADIOLOGICAL MANIFESTATIONS OF PTB IN DM

RADIOLOGICAL PATTERN	**NUMBER OF PATIENTS**		***PERCENTAGE***
	MALE	**FEMALE**	
U/L Cavitary disease	6	3	16%
U/L Nodular opacity	6	3	16%
B/L extensive lesion	17	6	39%
Lower Lung field TB	5	9	24%
Miliary TB	2	1	5%
Total	36	22	100%

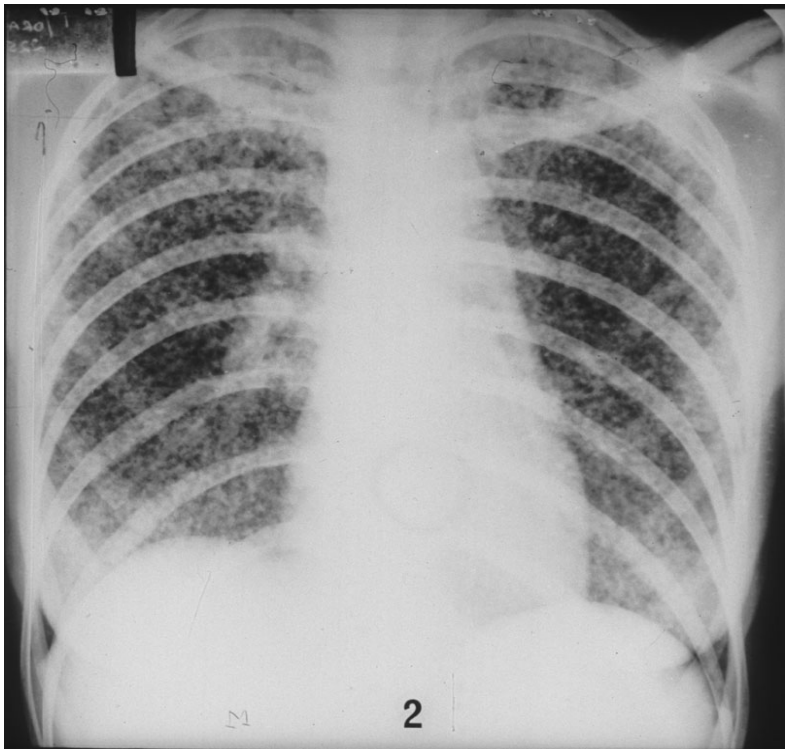
This table shows the chest roentgenographic changes of PTB in diabetics. B/L extensive lesion with multiple patterns (cavitary and exudative nodular opacities) is common in diabetics with poor glycemic control. Lower lung field TB accounted for about 24% of radiological manifestation.



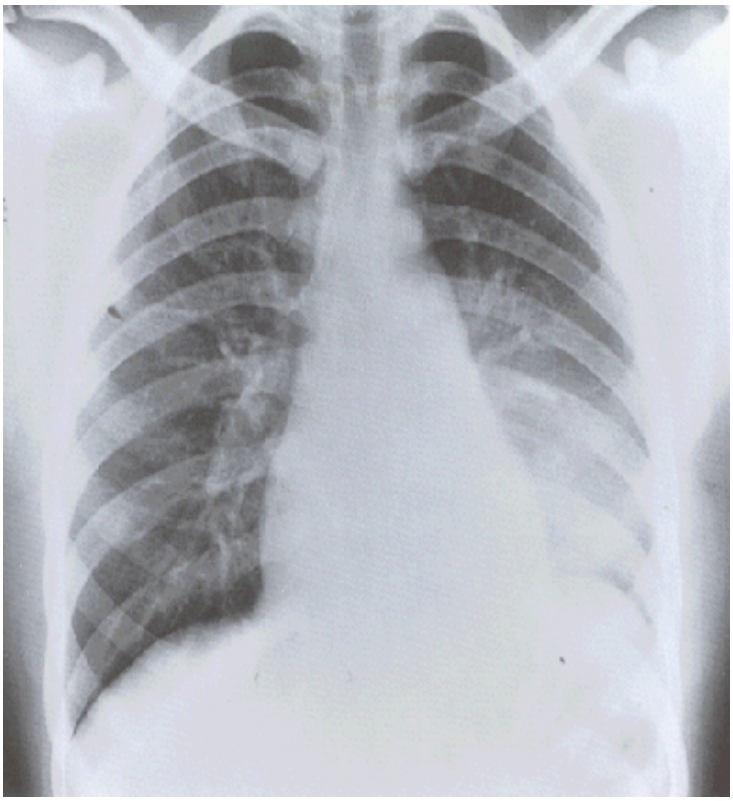
RIGHT U/L PTB



B/L EXTENSIVE PTB



MILIARY TUBERCULOSIS



LOWER LUNG FIELD TB

TABLE 6: METHODS OF DIAGNOSIS OF PULMONARY TUBERCULOSIS

Total Number of Pulmonary Tuberculosis: 58

Total Number of Pleural Tuberculosis: 5

Sputum Smear	Sputum/ Bronchial Wash AFB Culture	Number of Case	Percentage
Positive	Not done	30	51.7%
Negative	Positive	7	12%
Negative	Negative	21	36.2%

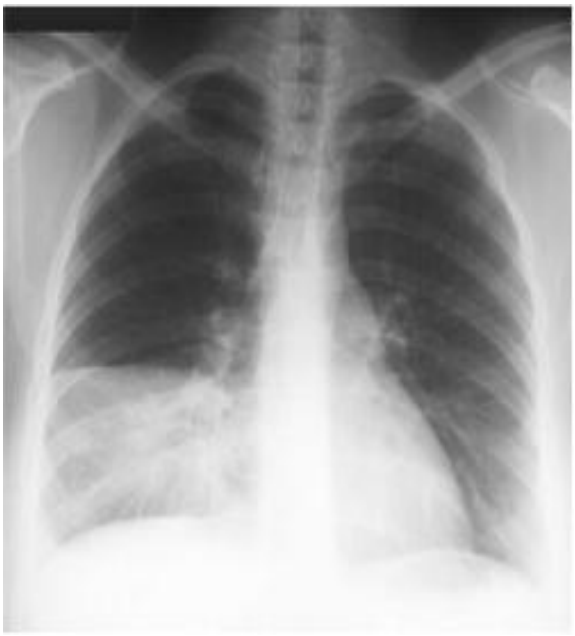
Sputum smear was positive in about 51% of PTB cases (n=30) and diagnosis was established by AFB culture in 12% of cases. In 36% of cases diagnosis was made on radiological grounds and therapeutic response to a trial of ATT.

Table 7: RADIOLOGICAL MANIFESTATIONS OF BACTERIAL INFECTIONS.

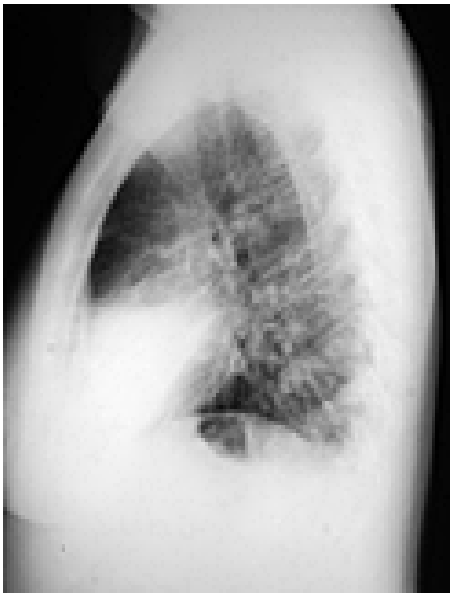
Pattern	**Number of cases**	**Percentage**
Consolidation	15	38%
Lung Abscess	12	30%
Bronchiectasis	7	17%
Diffuse Parenchymal/ Interstitial Opacities	6	15%
Total	40	100%

Among the radiological patterns of Pulmonary lesion caused by Bacterial infections, consolidation (38%) and Lung Abscess (30%) accounted for the majority.

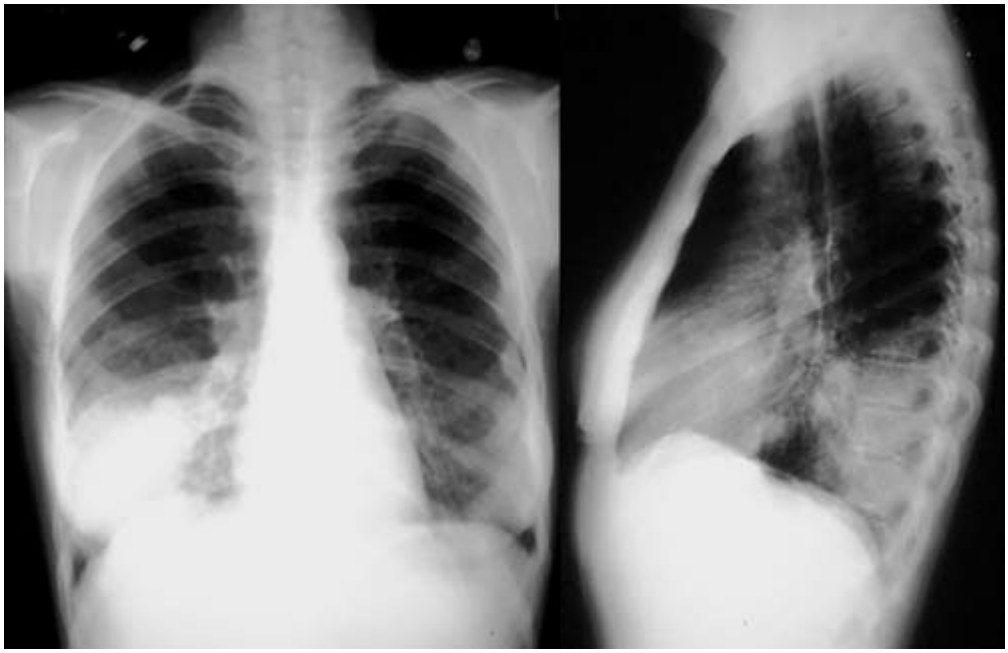
Out of the 7 cases of bronchiectasis, interestingly 3 cases were Type 1 Diabetics accounting for about 40 % and in all the 3 patients ,cystic fibrosis was ruled out by sweat chloride test.



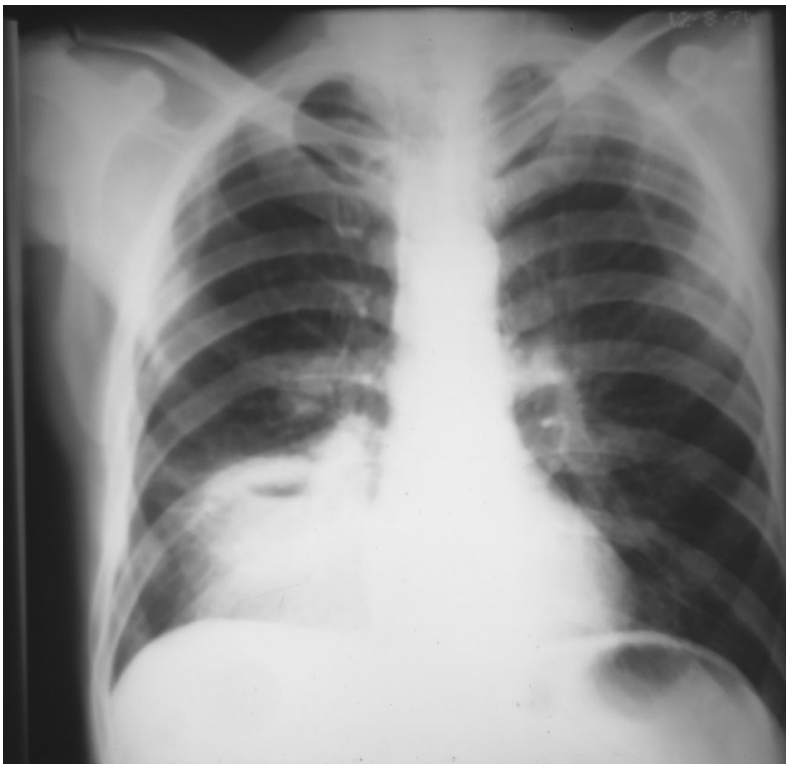
RIGHT M/L CONSOLIDATION-PA



RIGHT M/L CONSOLIDATION - LATERAL



RIGHT L/L CONSOLIDATION



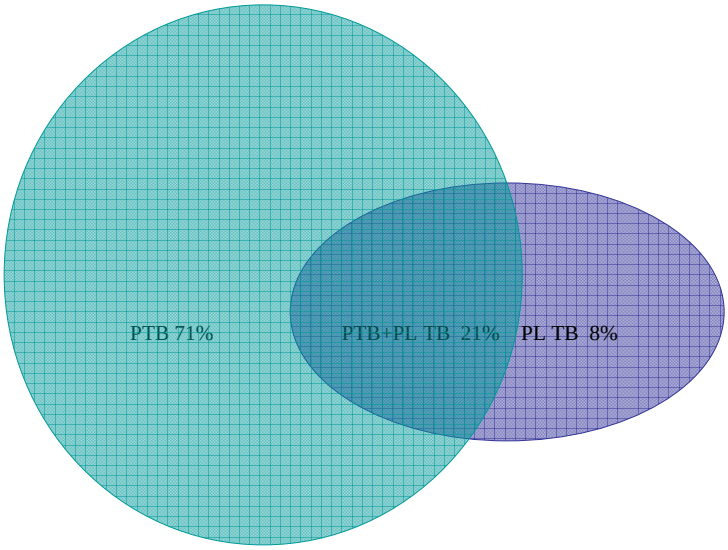
LUNG ABSCESS

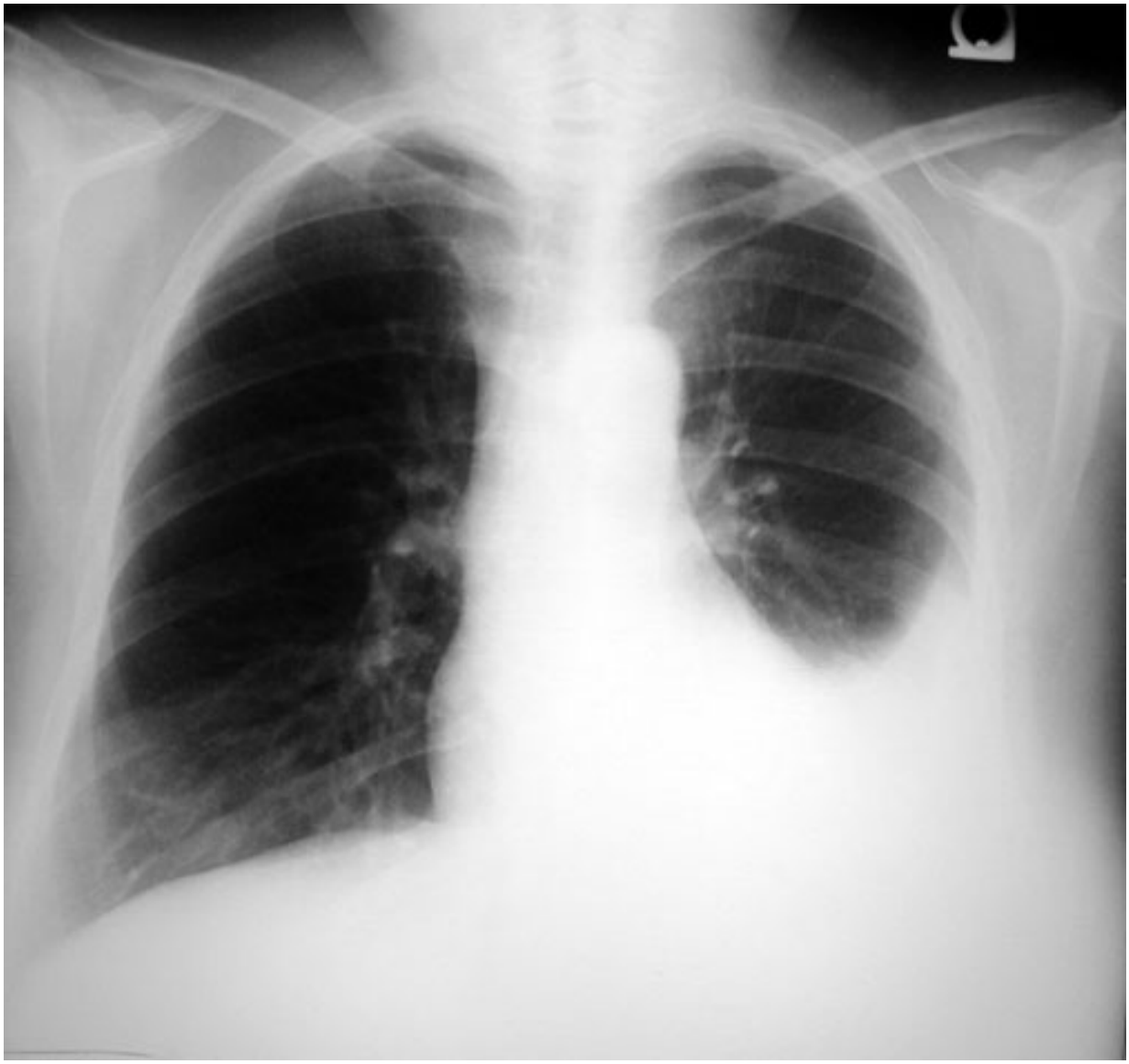
Table 8: PLEURAL MANIFESTATIONS IN DIABETES MELLITUS

Microbial Agent	**Pleural Disease**	**No underlying Parenchymal disease**	**Underlying Parenchymal disease**
Non Tuberculosis Infection	Parapneumonic effusion	Nil	4
	Empyema	Nil	8
	- Pyogenic	Nil	(5)
	- Hepatopleuro pulmonary amebiasis	Nil	(3)
Tuberculosis	Pleural Effusion	5	1
	Pneumothorax	Nil	2
	Hydro/ Pyopneumothorax	Nil	10

Out of 106 patients analysed, 30 patients had pleural involvement, accounting for about 28%. Among 63 patients with TB, pleural disease was observed in approximately 30% (n=18) of patients. Hepatopleuropulmonary amebiasis contributed to 10% of pleural diseases in diabetics.

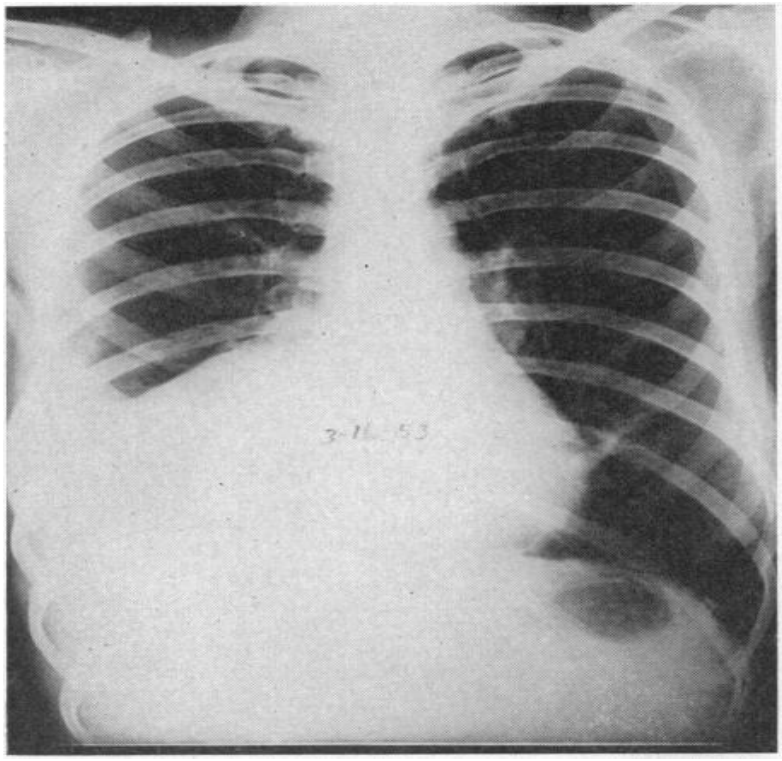
PLEUROPULMONARY TB IN DM

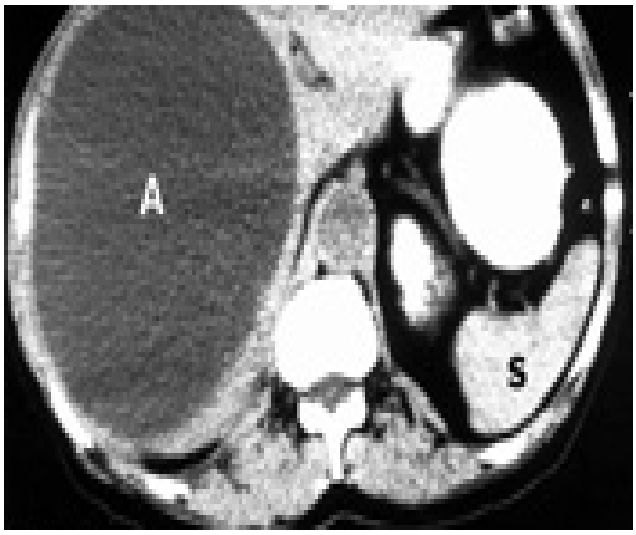




LEFT PLEURAL EFFUSION-TUBERCULOSIS

HEPATOPLEUROPULMONARY AMEBIASIS





AMEBIC LIVER ABSCESS -CT

DISCUSSION

DISCUSSION

A total number of 106 cases were analysed from Jan 2006 to June 2007. Of these 106 cases, 88% of the cases were Type 2 diabetics and 7% of the cases were grouped under Type 1 DM as shown in Table 1. This apparent increase in the incidence of pleuropulmonary infections in NIDDM may be due to the fact that Type 2 DM constitutes to about 90 to 95% of DM (3) and Type 1 DM sums only up to about 10%.

The association of PTB with Impaired glucose tolerance varies between 2 to 41% as reported by various research workers (32). As mentioned by M.M. Singh et al (4) apart from TB infection per se leading to alteration in glucose tolerance, the effect of other factors like fever, bed rest, malnutrition and drugs on glucose tolerance might have contributed to such high association between PTB and IGT in those studies. In our study the association of PTB with IGT was about 8%.

According to Ezung T. et al, duration of diabetes did not correlate well with prevalence of pulmonary infections unlike vascular complications

(17). From Table 2, it is evident that in a developing country like India where people are reluctant to seek early medical care, a high proportion of

patients are found to be diabetics incidentally at the time of diagnosis of pulmonary infection. This emphasizes the necessity of screening all patients with pulmonary infections irrespective of the etiology (TB or Non TB infection) for diabetes mellitus. LUNG is a “Mirror” reflecting most of the systemic disorders and Diabetes Mellitus is “No Exception to this Rule”.

Peak incidence of infections i.e. around 69% occurred between 3rd decade to 5th decade in synchronous with the study on influence of DM on manifestation and treatment outcome of PT published in International Journal of TB and lung Diseases (50). Though pleuropulmonary infections are not very common in elderly age group in our study, they tend to occur with increased severity .

In coherence with the study conducted by Feleke. Y. and Abdul Kadir et al (8) wherein the prevalence of TB among males was 59% and females 41%, in our study, the occurence of Diabetic Tuberculosis in males and females was 62% and 38% respectively. The occurence of Non-Tuberculous infection in men was 58% and in women was 42% close to the observation

of Miquel Falguere et al wherein male and female incidence of CAP in DM was 62% and 38% (1). Male preponderance is seen between the age group 35 – 54 yrs but in extremes of age group, sex predilection is lost and infections occur with more or less the same frequency in both sexes.

Regarding non TB infections in diabetics, about 60% of cases are due to Staph. aureus, Klebsiella and Pseudomonas and similar patters of non tuberculous infections among diabetics were reported by Koziel et al (11) from Harvard Medical School, Boston. However, due to lack of adequate facilities for detection of atypical, anaerobic organisms, the definitive etiological agent could not be identified in 28% of the cases in our study. Further rare infections due to Nocardia and Hepatopleuropulmonary Amebiasis were reported in a minority group.

From table 7, it is evident that consolidation and Lung Abscess were the major pattern of Lung infections caused by Bacteria. Analysis of pneumonia in diabetics discloses that around 30%of pneumonia is due to virulent Gram Negative organisms like Klebsiella and Pseudomonas .25% of pneumonia is due to gram positive organisms like Streptococcus Pneumonia & Staphylococcus aureus .Similar to the results of Etiology & Outcome of Pneumonia in DM by Miquel Falguera et al(1),where microbial agent was not identified in 30%of cases, etiology was not identifiable in 33% of pneumonia in

diabetics in our study also . On risk stratification of diabetics with CAP, majority of patients (about 60%) with poor glycemic control, were grouped into intermediate and high risk group according to CURB 65 scoring system

detailed in the previous section of methodology which highlights that infections tend to occur aggressively in uncontrolled hyperglycemic states.

In around one third of Lung Abscess cases ,organism was not isolated by aerobic culture although sputum Gram stain revealed Gram Positive Cocci and Gram Negative Bacilli, which could be an indirect evidence for anaerobic etiology .In our study, Staphylococcus contributes to about 30% of lung abscess as against 23.3% reported by Khakar et al(54).As mentioned earlier oropharyngeal colonization with Staphylococcus aureus is high in diabetics (36) and microaspiration of theses organisms leads to frequent suppurative lung infections in these patients. Klebsiella and Pseudomonas contributes to the rest in our patients and infection with GNB carries high risk for mortality.

In our study, 28% patients with Empyema had Non Tuberculous Bacterial infection. Among the pyogenic organisms isolated, Staphylococcus, Klebsiella and Pneumococcus contributed to 20 % each. 40% were due to Polymicrobial infection in contrast to 20% as observed by Brook and Frazier et al (21). 18% of PleuroPulmonary suppuration was due to Hepatopleuropulmonary

Amoebiasis.55% of Empyema in diabetics were due to Tuberculosis in this study in corroboration with the studies conducted by Acharya Preetam et al (22) & Volshyn Iam (10).

Most common causes of infective exacerbation in diabetics with Bronchiectasis were Pseudomonas and Staphylococcus similar to the observation in non diabetics as well. Interesting observation was that 3 patients of IDDM had Bronchiectasis and this was the only radiological pattern of pyogenic infections observed in IDDM. This observation may require insight into the impairment of local defense mechanisms in IDDM which makes them prone for recurrent respiratory infections and Bronchiectasis.

As expected in a high endemic country for Tuberculosis like India, Tuberculosis accounts for 60% of the pleuropulmonary infections in diabetics. Pleural involvement in Tuberculosis was seen in about 1/3 rd of cases as supported by studies on coexistence of PTB and DM by Wilcke et al (55) and Hussain et al (29).

There are many studies on roentgenographic findings of PTB in DM to quote a few are in references (5,23).Sosman and steidl et al defines “diabetic Tuberculosis” has a special radiological pattern consisting of

confluent, cavitary, wedge shaped lesion extending from the hilum towards the periphery, predominantly in lower zone to the extent of around 20%
(30). Multiple lobe involvement was the predominant radiological presenting pattern of TB accounting for about 39% (52), similar to the conclusion from a study on pulmonary TB in diabetics done by Joseph Morris et al in 1992 (51). Lower lung field TB accounted for 25% of the cases compared to 20% of LLFTB reported in the above study. But there are conflicting results as far as Lower lung field TB in diabetics is concerned and reported incidence varies from 0.2 to 18% (7). Miliary TB was reported in 5% of Tuberculosis patients with poor glycemic control.

Analysis of Table 6 shows that 52% of the Tuberculosis cases were diagnosed by Sputum Smear microscopy. Sputum/ Bronchial wash AFB culture contributed to diagnosis only in 12% of the cases and in the rest of the cases ATT was started based on clinical and radiological grounds. Similar results were observed by Prasad et al in which sputum AFB culture alone attributed to diagnosis only in 10% (52). Pointers towards diagnosis of PTB in sputum smear/ culture negative cases were poor glycemic control, H/o definitive contact with an infectious case, low BMI and characteristic radiological involvement & therapeutic response to ATT.

As mentioned earlier, pleural involvement in TB is seen in 30% of the patients and majority of these (around 70%) were associated with underlying parenchymal disease.All cases of Tuberculous Empyema were associated with underlying parenchymal disease in our study and Bacteriological confirmation was possible in 70% of the cases and similar findings were reported by Acharya Preetam et al in his study(22) .Empyema due to TB and non Tuberculous etiology required protracted treatment with parenteral antibiotics/ ATT and intercostal drainage. Despite such a long duration of treatment, persistence of pleural thickening resulting in trapped lung was much higher.

CONCLUSIONS

CONCLUSIONS

Following were the inference drawn from this study:

1. The peak incidence of pleuropulmonary infections in this study were in the age group of third decade to fifth decade. Thus it would be prudent to screen all patients in this age group presenting with respiratory infection, for diabetes mellitus(18).

2. Majority of pleuropulmonary infections of Non Tuberculous etiology were due to Gram Positive Organisms – Staphylococcus pneumonia and Streptococcus pneumonia (25%) and Gram Negative Organisms – Pseudomonas, Klebsiella, H. Influenza (40%).

3. The application of this knowledge is very important in tailoring early appropriate antibiotic therapy for diabetic patients where culture facilities are not available as even a short delay in initiating treatment may lead to rapid progression of infection leading to increased mortality and morbidity.

5. Risk stratification of Bacterial pneumonia in diabetes using CURB 65 scoring system shows that around 60% of patients were categorized under group 2 and group 3 suggesting that bacterial infections

tend to be more aggressive in diabetics especially those with uncontrolled hyperglycemia.

6. Pulmonary Tuberculosis tends to occur with increased severity in diabetics as evidenced by the occurrence of B/L extensive lesion with multiple radiological patterns in around 40% of cases in our study. Further to support this, bacillary loads were high among diabetics with poor glycemic control (as assessed by increased grading of sputum positivity).

7. Association of pulmonary infections with pleural involvement occurs in about 30% of diabetics demanding protracted course of antibiotics and ICD for a duration of about 6 – 8 weeks and increases the morbidity in such patients.

8. From the analysis of mortality among patients with pleuropulmonary infections and DM, predictors of mortality were a combination of advancing age, poor glycemic control, chronic debilitation with low BMI (especially among PTB patients), Diabetic keto Acidosis, multilobar involvement and bacteremia. Hence cases with the above mentioned risk factors require special attention and aggressive treatment of infection.

SUGGESTIONS

Diabetes and pulmonary infection is a *"deadly duo"*, one fueling the progression of the other. *Prevention is better than cure*-though sounds old, still holds good for most of the infectious epidemics. The following suggestions may be tried to prevent the double trouble of DM and pulmonary infections from sweeping our country.

1. Emphasizing the importance of adherence to treatment among diabetics and maintenance of blood sugar levels to near euglycemic state may in a long run decrease the incidence of respiratory infections in them.

2. Patient education regarding early approach to medical care for respiratory symptoms (which are neglected as "Common cold" very often) may decrease the occurrence of severe forms of infections.

3. As PTB remains as the single most common cause of pulmonary infections in diabetics, lowering the threshold for diagnosing PTB and early institution of ATT may limit extensive forms of the disease.

4. Trials regarding efficacy of vaccines in controlling the incidence of infections among high-risk diabetics (like those with uncontrolled hyperglycemia, tendency for "brittleness", elderly age group, IDDM) may be encouraged.

SHORTCOMINGS OF THE STUDY:

Due to the lack of adequate facilities for detailed microbial analysis including viral studies ,immunological studies for detecting atypical pathogens and anaerobic culture methods, definitive etiological agent could not be identified in 28% of Bacterial infections .

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ABBREVIATIONS

ABBREVIATIONS

DM	-	Diabetes Mellitus
IDDM	-	Insulin Dependant Diabetes Mellitus (or) Type 1 DM
NIDDM	-	Non Insulin Dependant Diabetes Mellitus (or) Type 2 DM
ADA	-	American Diabetes Association
IFG	-	Impaired Fasting Glucose
IGT	-	Impaired Glucose Tolerance
OGTT	-	Oral Glucose Tolerance Test
WHO	-	World Health Organisation
ATT	-	Anti Tuberculous Treatment
RNTCP	-	Revised National TB Control Programme
NADPH	-	Nicotinamide Adenine Dinucleotide phosphate.
HMP	-	Hexose Mono Phosphate Shunt Pathway
TNF $\propto$	-	Tumor Necrosis factor – Alpha

GNB	-	Gram Negative Bacilli
GPC	-	Gram Positive Cocci
PTB	-	Pulmonary Tuberculosis
LLFTB	-	Lower Lung Field Tuberculosis

MASTER CHART

MASTER CHART FOR PLEURAL /PULMONARY TUBERCULOSIS IN DM(1)

Sl. No.	Age	Sex	Time Interval	Radiological Pattern	Blood Sugar Level	Sputum AFB Smear	Sputum/ Bronchial wash AFB culture	Diagnosis
1	A	Y	a	2q	I	NEG		N
2	A	Y	c	2t	II	1POS		N
3	A	X	b	2t	II	1 POS		N
4	A	X	b	2r & 1g	III	2 POS		N
5	B	Y	c	2q	I	3 POS		N
6	B	Y	c	2t	II	NEG		N
7	B	Y	b	1e	II	NEG		N
8	B	X	c	2t	III	NEG		N
9	B	X	b	2r	II	NEG		N
10	C	Y	b	2t	III	SC POS		N
11	C	Y	c	2u	IV	NEG		N
12	C	Y	c	2q & 1g	II	NEG		N
13	C	Y	a	2q	I	2 POS		N
14	C	Y	b	2s & 1e	III	NEG		N
15	C	Y	a	2t	II	NEG		N
16	C	Y	a	2s & 1f	III	NEG		N
17	C	Y	a	2r	I	NEG		N
18	C	Y	b	2r & 1g	II	NEG		N
19	C	Y	a	1e	III	NEG		N
20	C	Y	a	2s	II	3 POS		O
21	C	Y	a	2s	III	2 POS		N
22	C	Y	a	2s	III	NEG		N
23	C	Y	a	2s	II	3 POS		O
24	C	X	c	2t	II	NEG		N
25	C	X	c	2s & 1f	III	3 POS		N
26	C	X	b	2t	II	NEG	S Positive	N
27	C	X	d	2t	II	SC POS		N
28	C	X	b	2q	I	2 POS		O
29	C	X	a	1e	II	NEG		N
30	C	X	a	2r	II	NEG		N
31	D	Y	a	2t	II	NEG		N
32	D	Y	c	2q	II	NEG	B Positive	N
33	**D**	**Y**	**d**	**2s**	**III**	**3 POS**		**M**
34	D	Y	c	2r	II	NEG		N
35	D	Y	b	2q & 1g	III	NEG		N
36	D	Y	a	2s	II	3 POS		O
37	D	Y	d	2r	II	3 POS		M
38	D	Y	a	2r	III	NEG	B Positive	N
39	D	Y	a	1e	II	NEG		N
40	D	Y	c	2s & 1g	III	NEG		N

41	D	Y	a	2s	II	3 POS		N
42	D	Y	a	2s	III	1 POS		N
43	D	X	d	2s & 1g	III	3 POS		N
44	D	X	b	2q	II	SC POS		M
45	D	X	a	2t	II	NEG		N
46	**D**	**X**	**c**	**2s**	**III**	**2 POS**		**O**
47	D	X	a	2t	II	NEG	B Positive	N
48	D	X	a	2t	II	2 POS		N
49	D	X	a	1e	II	NEG		N
50	D	X	e	2u	III	NEG		N
51	E	Y	e	2s	II	1 POS		M
52	E	Y	c	2s	III	1 POS		O
53	**E**	**Y**	**b**	**2s & 1g**	**IV**	**3 POS**		**N**
54	E	Y	a	2r	II	NEG	B Positive	N
55	E	Y	d	2s & 1g	II	2 POS		N
56	E	Y	a	2s	III	POS		O
57	E	X	c	2s & 1g	III	3 POS		N
58	E	X	d	2s	II	1 POS		O
59	E	X	b	2q	II	NEG	B Positive	N
60	E	X	a	2t	II	NEG	B Positive	N
61	**F**	**Y**	**e**	**2s & 1g**	**III**	**1 POS**		**N**
62	F	Y	d	2u	III	NEG		N
63	F	X	c	2s	II	3 POS		O

MASTER CHART FOR NON TUBERCULOUS PULMONARY INFECTIONS IN DM (2)

SL NO	AGE	SEX	TIME INTERVAL	BLOOD SUGAR	RADIOLOGICAL PATTERN	SPUTUM/BRONCHIAL WASH/PL FLUID /BLOOD GRAM STAIN & CULTURE	CURB SCORE
1	A	Y	c	p	3	Pseudomonas	
2	A	Y	b	r	3	Staphylococcus	
3	A	X	d	q	3	Pseudomonas	
4	B	Y	a	r	1F	Pneumococcus	I
5	B	X	b	q	1F	Staphylococcus	II
6	C	Y	a	q	1	Klebsiella	II
7	C	Y	b	q	1	Klebsiella	I
8	C	Y	a	r	1	Pseudomonas	I
9	C	Y	c	r	2E	GPC & GNB	
10	C	Y	a	q	2	Staphylococcus	
11	C	Y	a	q	2	Klebsiella	
12	C	Y	c	s	5		
13	C	Y	b	q	4	Not identified	III
14	C	Y	c	q	4	Not identified	II
15	C	X	a	q	1	H.Influenza	I
16	C	X	c	r	1E	Pneumococcus	III
17	C	X	b	r	3	Klebsiella	
18	C	X	c	q	2	GPC & GNB	
19	C	X	a	q	2	Staphylococcus	
20	C	X	c	q	4	Not identified	I
21	C	X	b	r	4F	Not identified	II
22	D	Y	a	q	1	Staphylococcus	II
23	D	Y	a	r	1E	Klebsiella	III
24	D	Y	d	p	3	Pseudomonas	
25	D	Y	c	r	3	Staphylococcus	
26	D	Y	d	r	2	Staphylococcus	
27	D	Y	d	r	2	Klebsiella	
28	D	Y	c	q	2	Pseudomonas	
29	D	Y	e	r	5		
30	D	Y	a	r	5		
31	D	Y	d	s	4	Nocardia	III
32	D	X	b	q	1E	Staphylococcus	I
33	D	X	a	q	1	Not identified	II

34	D	X	c	r	3	Pseudomonas	
35	D	X	a	q	2	Staphylococcus	
36	D	X	d	q	2	Pseudomonas	
37	D	X	b	q	4	Not identified	I
38	E	Y	d	r	1F	Klebsiella	II
39	E	Y	a	q	1	Not identified	I
40	E	X	a	q	1	H.influenza	I
41	E	X	e	r	2E	GPC & GNB	
42	F	Y	b	q	1	Pseudomonas	III
43	F	X	a	r	2	GPC & GNB	

KEY TO MASTER CHART

KEY TO MASTER CHART (1)

AGE INTERVAL

A- <25 YRS
B- 25-34 YRS
C- 35-44 YRS
D- 45-54 YRS
E- 55-64 YRS
F- >65 YRS

SEX

X- FEMALE
Y- MALE

TIME INTERVAL BETWEEN DIAGNOSIS OF PT &DM:

a- SYNCHRONOUS
b- < 1 YEAR
c- 1-5 YEARS
d- 6-10 YEARS
e- >10 YEARS

RADIOLOGICAL PATTERN:

1- PLEURAL

2- PARENCHYMAL

q- U/L CAVITY

r- U/L NODULAR OPACITY

s- B/L EXTENSIVE LESION

t- LOWER LUNG FIELD TB

u- MILIARY TB

e- PLEURAL EFFUSION

f- PNEUMOTHORAX

g- PYO/HYDROPNEUMOTHORAX

BLOOD SUGAR:

I- 140-200 MG/DL

II- 201-300 MG/DL

III- 301-400 MG/DL

1V- >400 MG/DL

DIAGNOSIS:

N-NEW CASE(79%)

M-MDR TB(6%)

O-RETREATMENT CASE(15%)

	DEATH
	TYPE I DM

KEY TO MASTER CHART (2)

AGE INTERVAL

A- <25 YRS

B- 25-34 YRS

C- 35-44 YRS

D- 45-54 YRS

E- 55-64 YRS

F- >65 YRS

SEX

X- FEMALE

Y- MALE

TIME INTERVAL BETWEEN DIAGNOSIS OF NON TUBERCULOUS INFECTION & DM:

a- SYNCHRONOUS

b- < 1 YEAR

c- 1-5 YEARS

d- 6-10 YEARS

e- >10 YEARS

RADIOLOGICAL PATTERN:

1- CONSOLIDATION

2- LUNG ABSCESS

3- BRONCHIECTASIS

4- DIFFUSEPARENCHYMALOPACITY

5- HEPATOPULMONARY AMEBIASIS

E- EMPYEMA

F- PARAPNEUMONIC EFFUSION.

BLOOD SUGAR LEVEL:

p- 140-200 MG/DL

q- 201-300 MG/DL

r- 301-400 MG/DL

s- >400 MG/DL

	DEATH
	TYPE I DM