Course Name: Pulmonary Function Test - Interpretation and Application in clinical practice
Professor Name: Dr Mayilanithi K
Department Name: Medicine
Institute Name: Chettinad Hospital and Research Institute
Week – 03
Lecture - 03

W3_L3_Indications for Pulmonary Function Testing

Hi friends, I am K. Mayilanithi and we working as a Professor in the Department of General Medicine. In this session, we are going to discuss about the indications for doing pulmonary function testing shortly known as PFTs. What are the objectives? We will start with indications for pulmonary function testing and we will discuss about complications of PFTs and contraindications of doing PFTs. At the outset, I would like to tell you that PFTs are not generally done in a patient with acute respiratory distress. We try to stabilize the patient, find out the cause, treat it.

PFTs are generally done only the patient is stable enough to do the investigations. This usually done in an outpatient setting or in the ward. First, we will discuss about indications for PFTs. We are going to discuss several indications for PFTs.

So, you know the types of PFTs static dynamic PFTs among all the PFT which one is commonly done, spirometry is the commonly done PFT which is easy to do, affordable and available everywhere. So, we will start the indications. First one, evaluating a patient with respiratory symptoms, signs or investigative findings suggestive of underlying lung disease. We want to find out really this patient has lung disease or not. So, spirometry helps us to differentiate obstructive and restrictive lung disease.

So, how will you find out whether the patient has obstructive lung disease or the patient has restrictive lung disease? So, what are the parameters that are shown using PFTs or the spirometry? One is FEV1, forced expiratory volume in first second, forced vital capacity and the ratio between the two. I guess you must be knowing to differentiate obstructive and restrictive lung disease on looking at the spirometry value. When the FEV1 is low, FEC is normal and the ratio between the FEV1 by FEC is reduced. We say that the patient has obstructive RB disease and in restrictive lung disease FEV1 is either normal or increased, the forced vital capacity is reduced, the ratio between the two is normal. Whether the spirometry if it is going to show normal value, we are going to say that the patient does not have underlying lung disease.

I would like to say few things, a patient with respiratory disorder, we have to take detailed history including occupational history, smoking status. History is meant for diagnosis of majority of the respiratory disorder. Investigations helps us to come to a conclusion. So,

without history we will not do anything. Even if the spirometry is going to be normal and the symptoms are suggestive of some disorder, we have to treat according to the symptoms, we do not go with PFT alone.

So, if the patient has obstructive RB disease, what will you do next? So, if the patient has obstructive RB disease, we want to know whether the patient has bronchial asthma or COPD. So, how will you differentiate bronchial asthma from COPD? So, you have done spirometry, it is so obstructive pattern. So, what will you do now? You will do bronchodilatation. What is the meaning of bronchodilatation? You are going to give a short acting bronchodilator; we are going to repeat the spirometry after 20 minutes. Look at the FEV1.

If the FEV1 is improved by more than 10 percent, we say there is reversibility that is indicative of bronchial asthma. If the FEV1 improvement is partial and there is no response, we say COPD. This is bronchial asthma and if there is no response COPD. So, what will you do next? You will do DLCO. DLCO helps us to differentiate the predominant subtype of COPD.

COPD has multiple subtypes like chronic bronchitis, emphysema and small RB disease. Do DLCO and differentiate these three. So, what are the common respiratory symptoms? I forgot to tell you about the restrictive lung disease. So, what will you do next if the patient has restrictive lung disease? Can you tell me an example for restrictive lung disease? Interstitial lung disease is a commonest subtype of restrictive lung disease. So, when a patient has restrictive lung disease assessed by spirometry, what will you do? Now, we will confirm the restriction by lung volume assessment, assess the lung volume to confirm restrictive lung disease.

Then you are going to measure DLCO. If the DLCO is reduced, it says the patient has restriction due to intra-paranormal disease. So, the problem is within the lung problem. If the DLCO is going to be normal, the problem is not in the lung. The restriction of the lung that means the patient is unable to expand the lung to the maximum because there is some problem in the pleura, chest wall or there is some problem in the muscles.

So, it is not in the lung outside the lung. And if the spirometry is going to be normal, what will you do? If the history is going to suggest you of bronchial asthma, do bronchodilator testing. So, you are going to do methacoline and you are going to you are going to record the FEV1. If there is significant drop in FEV1, we say that the patient has bronchial asthma. So, we never go with PFT alone.

History is much more important in the respiratory system. So, see the indications. So, a patient presenting with respiratory symptoms. So, what are the common respiratory symptoms? Dyspnea, it is nothing but breathlessness. The patient has wheezing.

Wheezing always says that the patient has obstructive airway disease, chronic persistent cough or nocturnal cough. Nocturnal cough is indicative of bronchial asthma and exercise induced cough. Exertional cough is common in patients with bronchial asthma. So, for this patient, what will you do? If the spirometry is going to be normal, ask the patient to do exercise and you are going to repeat the FEV1 at the end of exercise. After ruling out cardiac disease in a patient with chest discomfort or tightness, we will do PFTs.

So, what are the commonly done PFTs? Spirometry followed by lung volume assessment and DLCO. And patient has some physical findings. You found out that the patient has cyanosis. What is cyanosis? It is nothing but blueish declaration of the skin or the mucous membrane. This is due to excess amount of deoxygenated hemoglobin.

You are auscultating the chest wall. The patient has wheezing or crepitations. Here you want to find out what is the reason behind these findings. One patient has chest wall abnormality. The classical example being scoliosis.

What is such scoliosis? Normally, her spinal cord will be straight from the head till the lower end. But in a patient with scoliosis, there is bending of the spinal canal to one side. So, what will happen? This reduces lung expansion. So, scoliosis produces restrictive lung disease. Next one is we have done some lab that shows abnormalities.

You have done X-ray chest or CT thorax for some problem. It showed that the patient has flattened diaphragm or hyperinflation or some other findings. Both hyperinflation and flattened diaphragm are associated with emphysema, a subtype of COPD. Pulse oximetry or arterial blood loss analysis showing hypoxemia. Hypoxemia is nothing but reduced O2 level or hypercapnia.

That means increased level of CO2 within the body. We know very well lung helps us to take O2 into the blood and it also removes CO2 from our body. And before beginning, strenuous physical activity. This is not for everyone. The patient has underlying risk factor to have lung disease.

For example, chronic smoker. He wants to run a marathon. What will you do? You want to assess his lung status before doing strenuous activity. So, we have discussed about evaluation for a patient with suspected lung symptom signs or lab findings. The next one being a patient has a systemic disease. We want to find out whether the patient has developed respiratory manifestations or complications.

I am going to discuss this topic under two headings. One is autoimmune disorders, the other one being neuromuscular disorder. But there are so many other disorders that produces lung manifestations. You must be knowing about the meaning of autoimmune disorder. Classical example being rheumatoid arthritis and SLE.

Autoimmune disorders have varied manifestations on the lung, but common being interstitial lung disease, there one being pulmonary vascular disease. So, we have discussed about ILT previously. ILT is a form of restrictive lung disease. So, we will start with spirometry, we will assess the lung volume and we will do DLCO. The next example being neuromuscular disorder.

Here, I want to discuss about Guillain-Barre syndrome. In Guillain-Barre syndrome, there is it is also an autoimmune disorder. This disorder is characterized by weakness of the muscle starting from the lower limb and this weakness ascends up most of the time rapidly to involve the facial muscles also. While ascending up, this also produces weakness of the respiratory muscles like diaphragm and abdominal muscles. So, you are worried about respiratory muscle fatigue or weakness.

So, we have to assess the respiratory muscle function periodically to find out weakness as early as possible. If there is a respiratory muscle weakness, we have to intubate the patient and mechanically ventilate. So, what are the instigations you are going to do? You are going to assess the vital capacity, maximum inspiratory pressure and maximum expiratory pressure. So, next indication being the period indication being monitoring the disease severity and progression. You have diagnosed that the patient has COPD, we want to stage whether it is a mild, moderate or severe disease because treatment depends upon the severity.

Either we will give low dose steroids or we will give bronchodilators with steroid when the disease severity is going to go up. And in Guillain-Barre syndrome, we are going to assess the progression of respiratory muscle weakness, whether the muscle weakness is worsening or improving using PFTs. And what is the fourth indication? Objective assessment of response to therapy. For example, you have found out that the patient has bronchial asthma, you have started the patient on bronchodilators steroids. You want to know whether the patient is improving or not.

If there is no improvement, you want to add on some more drugs. And immunomodulator means the drug which is going to alter the immune system. That example being a malismar used in patients with bronchial asthma. So, we want to objectively assess whether there is improvement in therapy. So, what is the fifth indication? This topic was already dealt by Dr Arun Kumar, effects of drugs on the risk PFTs. There are so many manifestations caused by several drugs on the lung. But I am going to restrict myself to bronchospasm and interstitial lung disease.

Bronchospasm is caused by aspirin. Okay. And a sensitive individual when you are going to give aspirin, it produces symptoms like asthma. And interstitial lung disease, so many drugs produce interstitial fibrosis, the classical example being amiodarone. Which is used

in patients with cardiac problem. It is an anti-arrhythmic drug. And the sixth indication being to screen people at risk for pulmonary diseases, smokers.

So, what type of lung disease is common in smokers? COPD. They are prone to have bronchogenic carcinoma also. For smokers, you never wait for the PFT to show some problem to ask them to quit smoking. When a smoker is going to come to meet a healthcare professional, we have to advise them against smoking. So, don't wait for the PFT to show changes of COPD to advise them against smoking.

The second one is the patient had been exposed to pulmonary toxins, for example, radiation. A patient had CI breast, carcinoma of the breast. The patient underwent multiple therapies, removal of the tumor, chemotherapy and radiotherapy. After sometime, the patient is presenting with dyspnea. We want to find out whether the patient has developed lung fibrosis as a complication of radiation.

Here we will do spirometry followed by lung volume assessment and DLCO. And occupational lung disorder, it is a very big topic. So, what are the occupational toxins that can produce lung disease? We will see two examples.

One is Asbestos. Chronic exposure to asbestos fiber. We must have heard about asbestos sheets. This leads to asbestos. It produces interstitial lung disease. It produces so many other manifestations, but we are more worried about ILD.

So, how will you assess ILD? We know. We do spirometry followed by lung volume assessment and DLCO. The second one being silicosis. The patient has been exposed to crystalline silica. Silica is a particle that is seen in stones, sands.

In long standing sand miners, the patient is prone to have silicosis. It also produces restrictive lung disease. Next indication being to assess risk before surgical procedure. For all patients who is going for lung resection, either lobectomy.

What is lobectomy? This is lung. It has three lobes on the right side, two lobes on the left. So, this is removal of a lobe that is known as lobectomy or removal of the entire lung that is known as pneumonectomy. So, for all these patients, we will do PFT. On patient who has underlying risk like smokers or occupational lung disease or the patient has respiratory disorders like COPD, bronchial asthma, we will do PFTs before major surgeries like thoracic procedures, upper abdominal procedure or surgery before bright tumors.

For all other minor surgeries, we usually do not do PFTs. Surveillance following lung transplant. A patient is going to go for lung transplant. We usually ask them to do home spirometry. If there is any change, we have to ask them to meet the transplant team immediately. Here we can assess acute rejection, infection or obliterative bronchiolitis.

This complication develops late, a year after transplant. Here, this disorder obliterative bronchiolitis is an example for obstructive artery disease. So, patient will have findings suggestive of obstructive artery disease on spirometry. We have to pick up this condition early because this is an important cause for lung rejection after a year. And evaluate disability or impairment. The patient who has been exposed to dust and fumes at his workplace is eligible to get compensation under Workman's Compensation Act 1923.

So, if the patient has developed industrial lung disease or COPD, secondary to his workplace exposure to dust, fumes, toxins. So, what is the meaning of Cardiopulmonary Rehabilitation Program? It is a scientific based individualized program which has so many components like counseling, psychosocial support, education about the diet and health. It has so many components. This is done either to prevent heart or lung diseases or in a patient with underlying heart or lung disease, we are going to improve the quality of the life.

Here, we advise the patient against smoking, following healthy diet and other things. And for clinical research, you want to find out whether the traffic constable is working in the metro has developed COPD secondary to constant exposure to dust and toxins. The other example being sculptures, they have been constantly exposed to dust particle. We also we want to find out whether the patient has developed lung diseases, what are the risk factors for lung diseases, is there any relationship between smoking and increased risk of having lung disease in sculptures. We want to find out whether the patient has vitamin deficiency that produce post sculptures to have lung disease.

So, this is for epidemiological or clinical research, we can do PFT. So, we have discussed about indications for doing PFTs. Now, we will discuss about the complications. So, this is mainly for spirometry. Spirometry is socially safe. In spirometry, we are going to take a deep breath and the patient has to forcefully exhale.

So, this can induce dizziness. But while doing spirometry, we have to consider these four factors. I told you we are going to take a deep breath and we are going to forcefully exhale. So, there is maximum pressure generated within the thorax. It has impact on other organ systems including the brain. So, the patient is going to take a deep breath, the intra thoracic pressure comes down.

So, there will be excess venous return to the heart. So, there will be large swings in the blood pressure. We are going to take a deep breath, there is expansion of the chest wall and lungs. You will see its effect, spread of infection. The patient has some droplet borne infection like the patient has tuberculosis, it is a respiratory infection or COVID-19, classical example.

The patient is going to forcefully exhale. What will happen? There will be formation of droplets, this can spread and infect the nearby individuals, the bystanders or the healthcare

professionals doing this investigation. So, what are the contraindications? There are no absolute contraindications for PFT, but we have to consider whether the benefit is more compared to the risk of doing PFTs. And when the patient is acutely ill, we will not do PFT because the presence may not reflect the underlying lung function. Other contraindications? Hemoptysis, it is nothing but blood in the sputum. So, when the patient is going to forcefully exhale, it can aggravate hemoptysis.

And pneumothorax, what is pneumothorax? For example, this is the lung, this is the surrounding pleura. Pneumothorax is nothing but there is air in the pleural cavity. Usually in pleural cavity, there will be only minimal amount of fluid, there is no extra fluid or there is no air. If there is accumulation of air in the pleural cavity that is known as pneumothorax.

One of the costs being leakage of air from the lung to the pleural cavity. So, when the patient is going to do spirometry, what will happen? There will be excess air escaping from the lung into the pleura. So, the air in the pleural cavity expands, what else it is going to do? It is going to compress the lung. So, there will be impaired lung function. Other contraindications being unstable cardiovascular status.

The patient has ongoing chest pain, angina. The patient has hypertension and control hypertension or hypotension. He has cardiac failure which is decomposition. And the patient who had MI, stroke, pulmonary thromboembolism or major illness within 6 weeks do not do PFT. Patient has thoracic, abdominal or cerebral aneurysm.

What is the meaning? That is nothing but dilatation of the blood vessel. We were discussing about the 4 key factors known. Early generation of maximum pressure within the thorax. So, what will happen? I am sorry, the dilated vessels can rupture. And I already told you there will be large swings in the blood pressure.

So, its impact on the dilated vessel can cause rupture. So, because of the risk of rupture in a patient with underlying thoracic, abdominal or cerebral aneurysm, we do not prefer PFTs. And the patient has recent major surgery, thoracoabdominal surgery, craniotomy, ophthalmic surgery or middle ear surgery. Because of the risk of rupture of the suture, we do not advise them to go for PFT. And some acute illness, do not do PFT, wait for some time for the patient to improve. These are my references. Thank you.