

## Restrictive vs. Obstructive Disease (Dedicated to my good friend Joe Walsh)

The field of medicine has a long history of describing or classifying disease. Pulmonary disease is no different. Although there are hundreds and hundreds of diseases that can affect the lungs, we do (very) broadly describe almost all lung disease as either Restrictive or Obstructive. For the past 30 years or so a great deal of attention has been paid to the Obstructive group of diseases, but primarily Emphysema and Chronic Bronchitis. Together they are then lumped together as Chronic Obstructive Pulmonary Disease or COPD. It wasn't that long ago that Asthma was included in COPD, but since Asthma is really episodic and reversible, it has come out from under the COPD umbrella. Rather than go through the litany of known or speculated causes of COPD, I want to establish the similarities and differences between Restrictive and Obstructive disease.

There are over 200 known causes of Restrictive disease. For years it was just called Pulmonary Fibrosis, and since the cause is unknown in the majority of patients (60%) it is formally identified as Idiopathic Pulmonary Fibrosis or IPF. You might think we have known about IPF for a long time, but you'd be wrong. IPF was first described by two doctors in 1944. For many years we called IPF the "Hammon-Rich Syndrome" after these two doctors. It wasn't really defined and classified until 1975, and in recent years it has also been referred to as a UIP (Usual Interstitial Pneumonia)

So while the vast majority of Obstructive disease is made up of a handful of diseases, Restrictive disease comes in hundreds of entities. It is interesting to note that there are an estimated 125,000 to 200,000 patients afflicted with IPF in the United States. Contrast that with estimated of 13,000,000 to 16,000,000 patients with COPD, and you can begin to see why and how the allocation of resources has been decidedly in favor of research to treat COPD over IPF.

IPF can develop after exposure to dusts from both organic sources such as Bysinosis caused by breathing in cotton fibers during mill work or to inorganic sources such as Berylliosis seen in some workers in the fluorescent light bulb industry. We see IPF in patients who have been exposed to asbestos and silica particles as well. The list is far too long to cover here. Regarding the *symptoms* of IPF, it doesn't really matter if *we do or don't* know the cause of the fibrotic changes in the lung. It may or may not guide the medical or surgical treatment plan for the patient. This includes lung transplantation.

Since every patient is different, it might be an interesting exercise to look at a new patient through the eyes of the pulmonologist. Let's begin with a hypothetical patient who is seeing their pulmonologist for the first time. Our male patient is already on nasal oxygen, has had some pulmonary function testing and complains of:

Shortness of breath, especially with exertion	Cough
Significant drops in O <sub>2</sub> sats with activity	Fatigue
Mild to moderate Pulmonary Hypertension	Clubbing of the fingers
Unexplained weight loss	Poor 6 minute walk results
Decreased DLCO (diffusion of oxygen into the lung)	Muscle aches

Can you tell based on the above information whether the patient has COPD or IPF? Not so easy is it? What other information would you like? A little more history? So the patient does have a harsh cough...but it is dry. The patient was a smoker in the past, but quit over 25 years ago. The rest of the pulmonary function study? Now you're thinking. Remember, pulmonary function testing measures both the *flow rates* of test subjects, and the *volume of air* in the various compartments of the lungs. Okay, here are a couple of more bits of information. The patient's expiratory flow rate (FEV<sub>1</sub>) is 115% of his *predicted* normal. (Usually 75-80%) He can really blast out that air on command. However, the amount (volume) of air he blows out (his FVC, forced vital capacity) is only 55% of his predicted. Remember normal values for pulmonary function studies are based on a person's **height** and **age**. The clinical picture becomes a little clearer now doesn't it? With COPD we know the hallmark in their PFT's is *reduced* expiratory flow rates. The DLCO is almost always reduced in both conditions, so while helpful, it is not diagnostic by itself. Where do we go next...we get a work history from the patient. In this patient there is nothing remarkable about his work history. What next?

This is a good question and most likely the patient is on his way to the radiology department for both a standard CXR and a High Resolution Cat Scan (HRCT). It wasn't that long ago that almost all patients with suspected IPF had to undergo an open lung biopsy to be absolutely sure they could confirm under the microscope the characteristic cell changes that go with the diagnosis. Over the past 10 years however, HRCT has begun to replace that invasive procedure. There are other tests used to fine tune the diagnosis of IPF but currently the HRCT is beginning to replace the open lung biopsy as the standard diagnostic tool.

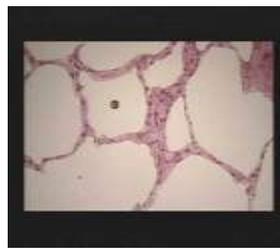
So now we get the results of the HRCT and sure enough all of the criteria for IPF are found. An HRCT of a patient with COPD is very, very different from a patient

with IPF. At this point the pulmonologist and maybe cardiologist have probably consulted with the radiologist and based on the patient's history and physical, pulmonary function studies, arterial blood gases, 6 minute walk, and of course the radiologic findings, the diagnosis of IPF can be made.

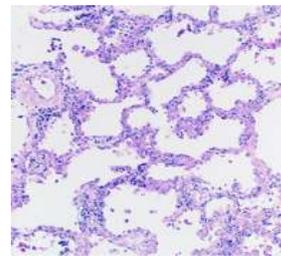
Maybe a picture here will be worth 1,000 words. The balloon on the left represents the lungs of the COPD patient; hyperinflated and with a great deal of destruction of the functioning surface area of the lung itself. The balloon on the right represents the lungs of a patient with IPF. Much reduced in volume, but with little or no damage to the airways of the lung.



COPD vs. IPF



Normal Alveoli



Alveoli with IPF

Look at the other two illustrations. Alveoli are where the action takes place in the lung. Oxygen and carbon dioxide are exchanged here so we can bring enough oxygen in, and eliminate carbon dioxide as it is produced. In the normal lung the space between the alveoli and blood supply is very small. (7/25,000ths of an inch). Oxygen diffuses very quickly (3/4 of a second) and easily from the alveoli into the blood. You can see this in the picture of the normal alveoli above. In complete contrast to this, the distance between the alveoli and the blood supply with IPF is greatly increased. You can see how thick the membrane is in the IPF picture. I have often told my respiratory therapy students that it is like a brick layer putting down another layer of cement between each layer of bricks. The greater the distance between the alveoli and blood supply, the harder it is for oxygen to “diffuse” from the alveoli into the blood. This is why the patients diffusing capacity is so markedly decreased, especially as the disease progresses.

With COPD there is actual destruction of functioning lung tissue, including both the alveoli, *and* the blood supply to that alveoli. With IPF, not only is the distance for oxygen to travel increased, but the normal elastic lung tissue is replaced with fibrotic scar tissue. It simply doesn't allow easy expansion of the lungs, like the small balloon in the picture, if you can't get much air in; you certainly can't get much air out can you? We often say the IPF patient has “stiff lungs.”

Another analogy I have used with my RT students to describe the “restrictive” process is to show them a picture of Andre the Giant. Andre the Giant was a very popular professional wrestler in the 1970’s and 1980’s. Maybe you knew him as a wrestler, maybe you saw him as the gentle giant in the movie “Princess Bride.”



Andre’s hands



Andre vs. Hulk Hogan



Andre in the “Princess Bride”

To get the visual, imagine you are simply trying to breathe in, and Andre has his huge hands around your lungs saying “Oh no you don’t.” You can just imagine how hard it would be to inflate your lungs. You would really have to “work” just to get air in, and then when you do get air in, there is almost nowhere for it to go down at the alveolar level. Quite the double whammy eh?

It is interesting to note that both IPF and COPD result in increased work of breathing or shortness of breath. What is so very different are the reasons for the shortness of breath. Another similarity is in the use of Prednisone in the treatment of both COPD and IPF. Oxygen is probably the most important “drug” prescribed for both groups. Although the causes of the low blood oxygen levels are very different, once you are a member of the “Hypoxic Club,” you are a member for life...pun intended! Unless Pulmonary Hypertension is also diagnosed, that’s about where the similarities in treatment end. Patients with IPF alone rarely need inhalers of any significance as they don’t have a reversible airway component to treat as we do in COPD. A wide variety of other drugs specific to IPF are available and being utilized. A number of promising new drugs are (as always) just over the horizon.

Although IPF has been almost overlooked compared to COPD, it has recently begun to get the attention and research dollars it so richly deserves. Currently, about 40,000 deaths per year are attributed to IPF. IPF is still a pretty rare disease compared to COPD. If 100 new patients walked in to a pulmonologists office, right around 80 of them would have COPD. *Maybe* 5 or so of them would eventually be diagnosed with IPF.

Interestingly, the penultimate treatment for both groups is of course lung transplantation. Up until 2005, lungs for transplant were allocated purely by waiting time on the list. After May of 2005 lungs for transplantation were allocated on an objective scoring system. IPF patients may get a single or double lung transplant based on many factors. Survival rates and admitting criteria vary tremendously from institution to institution, so any patient with either COPD or IPF considering lung transplantation should get their Google fingers busy and check out everything they can before making such a huge decision.

On a personal note, my own niece, Melitta, who was diagnosed with Primary Pulmonary Hypertension (a uniformly fatal disease) at 19 years of age, has had both a double lung and single lung transplant. She is now 34 years old, off oxygen, and going to Chef's school as I type this.



Melitta on day of Diagnosis



Melitta "waiting for the call"



Melitta today with her son Sam

One more thing, I would be remiss if I didn't mention the importance of exercise, diet, and education. My colleagues in pulmonary rehab have told me amazing stories of functional improvement in patients even with advanced IPF. The more you can condition your muscles to use less oxygen to do the work, the less short of breath you will be, the better your brain will work, and you will have a much improved overall quality of life. This would be especially true if you were listed for a transplant and just "waiting for the call."

To summarize in a slightly different way. Back in 1937, the Gershwin brothers wrote the "you say potato, and I say potahto" song for a Fred Astaire movie. With apologies to all those originally involved, and you can sing along if you like..

"You say Restrictive, and I say Obstructive,  
Who cares what you've got, they both are destructive,  
Restrictive, Obstructive, they both are destructive,  
Let's call the WHOLE thing off!"