

THE STORY BEHIND LIGHT'S CRITERIA

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When I was an intern in medicine at Johns Hopkins Hospital in Baltimore Maryland in 1968-1969, there was a period where I had a large percentage of patients who had a pleural effusion. The chief resident, Dr. Richard Winterbauer, would make rounds about midnight and would always ask me what the thoracentesis revealed. At that time we would routinely measure the cell count and differential, the glucose, the protein and do smears and cultures on the pleural fluid. I would ask Dr. Winterbauer the significance of the various pleural fluid findings and for the most part he had no answer.

It was at this time that additional measurements were being made on blood such as the lactic dehydrogenase (LDH), SGOT and SGPT. At about the same time, blood gas machines became available that would allow one to accurately measure the pH, PCO₂, and PO₂ of body fluids. I theorized that some of these new measurements might be useful in the differential diagnosis of pleural effusion. After doing a literature review, I developed two hypotheses. The first was that the pH of pleural fluid would be lower in tuberculous pleural effusions than other exudative pleural effusion. The basis for this hypothesis was an article in the Scandanavian Journal of Respiratory Disease that purported to show this (1). My second hypothesis was that LDH isoenzymes would be useful in the differential diagnosis of exudative pleural effusions. In order to get the absolute value of the LDH isoenzymes, I needed to have the total LDH in the pleural fluid and the serum. A previous study on pleural fluid LDH concluded that the pleural fluid LDH was elevated in malignant pleural effusions compared with other pleural effusion (2).

I submitted a proposal to the Institutional Review Board and received their approval. The blood gas machine was in the pulmonary function laboratory and I could measure all the pleural fluid blood gases myself. The clinical laboratory would measure the protein, LDH, and glucose in the serum and pleural fluid without charge. However, I did have to come up with some funds to pay for the LDH isoenzymes. I received a small grant from Johns Hopkins Hospital to fund this.

In order to get called when patients with pleural effusions were admitted, I made a deal with my fellow interns and residents. If they would call me when they did a thoracentesis, I would do the cell count and differential on the pleural fluid. These were duties for which they would normally be responsible. I found out in a hurry that with this arrangement I got called often in the middle of the night about pleural effusions.

One of the first patients I studied was a young man with an exudative lymphocytic effusion. His pleural fluid pH was 7.40. The patient turned out to have caseating granulomas on the needle biopsy of his pleura. So much for the first hypothesis. Shortly thereafter another patient had a pleural fluid pH of 6.95. The pleural fluid was clear yellow and the pleural fluid glucose was not reduced. However, the pleural fluid grew Streptococcus pneumoniae and the patient eventually developed a frank pneumococcal empyema. This was the first case suggested that a low pleural fluid pH might be an indicator of a complicated parapneumonic effusion (3).

Over a two year period I studied over 150 pleural effusions. I submitted an abstract of my preliminary findings to the American Thoracic Society for their annual meeting in 1971. The abstract was rejected. I was devastated.

In early 1972 Johns Hopkins had a reunion for some of its alumni. My mentor, Dr. Wilmot C. Ball, Jr., suggested that I present something on the pleural fluids that I had been studying. At that time transudates and exudates were usually separated by using a protein level of 3.0 gm/dl (4). I elected to see how this would work on my set of pleural effusions. On one rainy, sleety Sunday in Baltimore, Maryland, I spent several hours with a pencil and graph paper plotting protein levels, LDH levels and ratios of protein and LDH in the serum and pleural fluid.

When I examined my plots, it was obvious that no single value of any of these measurements correctly identified all transudates and exudates. If the cutoff was made high enough so that all transudates were below the cutoff level, then some exudates would be classified as transudates. My objective at that time was to identify all exudates correctly. Therefore I elected to make the cutoff points such that no transudates were above the line. I noticed that when I did this, some exudates were in the transudative range for each of the measurements. However, I also noticed that if you used three different cutoff levels such that no transudates were above the cutoff line, one could identify almost all transudates and exudates correctly. The three cutoff points that I found were a protein ratio greater than 0.5, an LDH ratio greater than 0.6 and an absolute pleural fluid LDH greater than two thirds the upper normal limit for serum. An exudative effusion met at least one of these three criteria while a transudative effusion met none.

I presented this data to the alumni and they did not seem particularly impressed. American College of Chest Physicians. I also submitted an abstract on the separation of transudates by the above criteria to the American College of Physicians in 1972 (5). It was accepted for an oral presentation in Atlantic City. This was the only oral presentation that I ever participated in where the audience graded the contents of the presentation. I got at most average marks - certainly nothing to suggest that these cutoff levels would still be in use almost forty years later. Nevertheless, I wrote

the paper and submitted it to the Annals of Internal Medicine. There it was accepted with minimal revisions (6).

The first reference to Light's criteria that I am aware of was published in 1989 (7). Since the original publication in 1972, there have been many studies comparing other measurements to Light's criteria for the separation of transudates and exudates, but in general Light's criteria have been proven to be better than anything else. I am amazed that after 38 years Light's criteria are still being used.

I believe that there are several lessons to be learned from my experience in developing Light's criteria. First, if you want people to cooperate with you on your research, you need to make it worthwhile for them. In this case, I did some of the work that they would otherwise have to do. Second, although research is best done when it is hypothesis driven, it is worthwhile to look at your data to determine if there are other interesting findings. Third, if you initially submit your work and it is not particularly well received, do not give up. Remember the first abstract on Light's criteria was turned down.

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