For 128 pleural fluids, the relationship between the protein content and the reading for the specific gravity obtained from a refractometer calibrated for urinary specific gravity was analyzed. The refractometer gave falsely high levels for the specific gravity of the pleural fluid. A reading for 1.019 (rather than 1.016) corresponded to a concentration of protein of 3.0 gm/100 ml, and each deviation of 0.005 (rather than 0.003) corresponded to a concentration of 1 gm/100 ml; however, determinations of the concentration of protein in the pleural fluid directly from the refractometer's scale for protein (calibrated for serum) was rapid and accurate. Calculation of the protein content of the pleural fluid from the reading for specific gravity on the refractometer is erroneous and sometimes misleading.

The specific gravity of pleural fluid is used to distinguish transudative from exudative pleural effusions, because it closely correlates with the protein content. A specific gravity of 1.016 corresponds to a level of protein of 3.0 gm/100 ml. Recently, we have observed that the values for specific gravity reported for pleural fluids are much higher than one would expect from the protein content of the fluid. It was found that the values for specific gravity were being obtained from a refractometer which is calibrated for urinary specific gravity, rather than the specific gravity of pleural fluid. Subsequently, I have found that this is a common practice. The purpose of this study was to investigate the relationship between the specific gravity (as read for urine) from the refractometer and the protein content of the pleural fluid.

Materials and Methods

Pleural fluids were obtained from 128 patients with pleural effusions from various causes. The protein content was measured by the biuret method. One drop of each sample of pleural fluid was placed in a temperature-compensated hand refractometer (American Optical 10400), and the corresponding scale reading for the specific gravity (calibrated for urinary specific gravity) and the protein content (calibrated for serum) were recorded.

Results

There was a close correlation ($r = 0.966$) between the reading obtained for the specific gravity

![Figure 1. Relationship between concentration of protein in pleural fluid and specific gravity (SG) read from refractometer. Solid line is regression line derived from our data. Dotted line is relationship between level of protein and specific gravity determined with hydrometer.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21064/ on 06/27/2017)
from the refractometer and the protein content of the pleural fluid (Fig 1) as measured by the biuret method; however, the relationship between the specific gravity obtained in this manner and the protein content differed markedly from the usual relationship between specific gravity and protein content (dotted line in Fig 1). A protein level of 3 gm/100 ml corresponds to a specific gravity of 1.019 on the refractometer but only 1.016 with the hydrometer. A protein level of 6 gm/100 ml corresponds to a specific gravity of 1.035 on the refractometer but only 1.025 with the hydrometer. The equations (Fig 1) defining the relationship between the hydrometric specific gravity and the refractometric specific gravity are quite different. In order to increase the protein level by 1 gm/100 ml on the refractometer, the specific gravity must increase 1/187.7 or 0.0053, while to increase the protein level by 1 gm/100 ml on the hydrometer, the specific gravity needs only to increase by 0.0028.

Nevertheless, the protein content of the pleural fluid could be rapidly estimated using the refractometer. The standard error of the estimate for the data in Figure 1 was 0.42 gm/100 ml. When the scale for the serum level of protein from the refractometer was used, there was a very close correlation between the level of protein via the biuret method and the level via the refractometer.

**DISCUSSION**

The refractive index and the specific gravity of a liquid are dependent upon the total solids dissolved in the liquid; however, the relationship between the refractive index and the total solids is different for urine than it is for serum. For a given change in total solids, there is a smaller change in the refractive index for urine than for serum. Therefore, the specific gravity of serum should be overestimated on a refractometer calibrated for urinary specific gravity, as was the case in this study (Fig 1).

In the past, measurement of the specific gravity of the pleural fluid was useful because it was a rapid way to estimate the concentration of protein in the pleural fluid. Now, since one can rapidly and accurately estimate the protein content from the refractometer, it appears that measurements of the specific gravity of pleural fluids, at least with refractometers, should be discontinued. It is circuitous to record a specific gravity calibrated for urine and then convert this specific gravity to the concentration of protein; however, if the refractometer's scale for specific gravity is used, it is important to remember that 1.019 (rather than 1.016 on the hydrometer) corresponds to a concentration of protein of 3.0 gm/100 ml and that a deviation of 0.005, rather than 0.003, corresponds to a concentration of 1 gm/100 ml.

**REFERENCES**