Communications to the Editor

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Pulmonary, Chest Wall, and Lung-Thorax Elastances in Acute Respiratory Failure

To the Editor:

Katz and associates (Chest 1981; 80:304) report the usefulness of compliances versus elastances as clinical indices. In regard to changes in mechanics with incremental PEEP, they concluded that chest wall elastance (Ecw) remains fairly constant, whereas lung-thorax elastance (ELT) and lung elastance (EL) increase one-to-one; however, lung-thorax compliance (CLT) increases only half as much as lung compliance (CL), thus making ELT more useful than CLT. Their Figure 4C shows just the opposite, however, in that ΔCLT is about twice ΔCL. It is possible to show briefly that the latter is not possible, and then to suggest how the discrepancy may have arisen.

From the expression for addition of compliances in series, 1/CLT = 1/Ccw + 1/CL, one may readily show by differentiation that (for constant Ccw) ΔCL = (CL/CLT)ΔCLT = (ELT/EL)ΔELT. Since ELT > EL, then ΔCLT must always be less than ΔCL. Figure 4C could show the opposite if x and y coordinates had been inadvertently interchanged. Indeed, this was the case, as shown below in Figure 1 where values were calculated from the basic data in Table 4 of Katz et al. Further scrutiny shows that x and y were actually interchanged in all four panels of their Figure 4. All data have been replotted here in Figure 1, and new regression coefficients computed.

It is of interest that in 75 percent of the measurements, ΔELT was less than ± 5 cm H2O/L. Figures 1A and 1B show separate regressions in this interval (dashed lines) and suggest that in most cases ΔEcw may contribute almost as much as ΔEL. The conclusion that EL is much greater than ΔEcw would appear to be weighted primarily by the extreme cases where lungs became almost inextensible at high PEEP.

Finally, concerning the conclusion that E is a more sensitive index of deterioration than C, it is fair to point out that relative changes in magnitude are exactly equal in either case. For example, for E = 1/C, one has dE = -1/C²dC, or for a relative change, dE/E = -dC/C. Consequently, no real advantage need accrue from the choice of one over the other.

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FIGURE 1. Relationship between changes in elastance and compliance caused by increments of 5 cm H2O in PEEP.