Comparing Survival Curves Using an Easy to Interpret Statistic

Kenneth R. Hess

Abstract
Here, I describe a statistic for comparing two survival curves that has a clear and obvious meaning and has a long history in biostatistics. Suppose we are comparing survival times associated with two treatments A and B. The statistic operates in such a way that if it takes on the value 0.95, then the interpretation is that a randomly chosen patient treated with A has a 95% chance of surviving longer than a randomly chosen patient treated with B. This statistic was first described in the 1950s, and was generalized in the 1960s to work with right-censored survival times. It is a useful and convenient measure for assessing differences between survival curves. Software for computing the statistic is readily available on the Internet. Clin Cancer Res; 16(20); 4912–3. ©2010 AACR.
samples can be used to estimate the variability of the statistic in the original samples. We can use this measure of variability to estimate approximate confidence intervals for the statistic.

To illustrate the use of the statistic $Pr\{x > y\}$ for comparing survival curves, I used two published datasets. The first dataset is 76 patients with Ewing’s sarcoma who were treated at the NCI (8). The comparison is between 45 patients with low serum lactic acid dehydrogenase (LDH) and 31 patients with high LDH (Fig. 1). For these data, $V = 0.89$ with approximate 95% confidence interval, 0.87-0.91. Here the numeric value of the $V$ statistic, 0.9, is consistent with the large separation in the survival curves. The second dataset is 89 patients with locally advanced nonresectable gastric carcinoma (9). The comparison is between 44 patients treated with chemotherapy and 45 patients treated with chemotherapy plus radiation (Fig. 2). For these data, $V = 0.61$ with approximate 95% confidence interval, 0.57-0.65. Here the numeric value of the $V$ statistic, 0.6, is consistent with the modest early separation of the survival curves. The interpretation of the $V$ statistic is that a randomly chosen patient treated with chemoradiation will have about a 61% probability of surviving longer than a randomly chosen patient treated with chemotherapy alone. The hazard ratio comparing chemoradiation to chemotherapy alone is 0.89 with $P = 0.60$. Thus the $V$ statistic better conveys the visual separation in the survival curves and has a simpler interpretation.

$Pr\{x > y\}$ yields useful results when survival curves are divergent (curves are initially close and then separate later in time) or convergent (curves are initially separate and then come together), but crossing survival curves may present a problem. For example, when curves cross near their median values with early and late separation, $Pr\{x > y\}$ may be close to 0.5. In effect, the separation in the survival curves on the left of the crossing point cancels out the separation on the right of the crossing point. In addition, $Pr\{x > y\}$ is not useful for comparing more than two survival curves (except in a pairwise fashion).

**Disclosure of Potential Conflicts of Interest**

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**References**
