Letter to the Editor

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In two studies, Tan (1, 2), using a large number of cases, investigated the effect of varying radiance intensities on the level of serum bilirubin concentration in neonatal jaundice. He arrives at the conclusion that "an asymptotic regression of bilirubin response to increasing radiance is present." In response, Wiese and Ballowitz (6) state that Tan's conclusion depends solely on the presentation of the measured data (5, 7), and they argue from a mathematical model applying Tan's data that the dose-response relationship shows no saturation point.

Tan describes his data by means of an empirical logarithmic function, commonly used in pharmacology to characterize dose-response relationships. Wiese and Ballowitz, on the other hand, apply a pharmacokinetic model to interpret Tan's findings. This model is based on the assumption that in phototherapy the serum bilirubin concentration follows an exponential function.

The different presentations do not render mathematically equivalent functions. In transforming the data, both Tan and Wiese try to illustrate the dependency of bilirubin elimination on radiance intensity as a straight line. Tan did so by computing the logarithm of the values of the x axis, while Wiese and Bullowitz used the ordinate values. The opposing conclusions drawn by the authors are not only theoretically meaningful, but have practical importance, since halogen phototherapy lamps with high radiant power are now available. However, it is not clear whether the increase of radiant power leads to a more efficient therapy or whether there is a limited efficacy for the treatment.

In order to compare the measured values with the two different functions proposed by the above authors, we computed the functions and plotted them together with Tan's data in linear scaled diagrams (Fig. 1, *A* and *B*). It becomes evident that the assumed functions based on the model of Wiese and Ballowitz dashed *lines*, Fig. 1) do not represent the measured values more adequately than Tan's empirical functions *solid lines*, Fig. 1). On the contrary, the functions deduced from the model do not fully account for the tendency shown in the data, namely that with increasing radiance the increase in therapeutic efficacy is reduced. This tendency is described more adequately by Tan's empirical logarithmic function.

However, even if the measurements collected from a large number of patients are deemed less significant when compared to the mathematical model, the conclusions of Wiese and Ballowitz, namely that the *e* function does not show a tendency to saturation, remains misleading. Presenting the function proposed by Wiese and Ballowitz in a linear scale, it becomes evident that this function also shows a decreasing slope with increasing intensity. Indeed the limit of the function is approached only with an extremely high radiance intensity.

The question arises, then, whether other factors have previously limited the applicability of the model. Apart from the above mentioned deviation between the mathematical model and the data measured by Tan, indications of this limitation can be inferred from the effect of so-called intermittent phototherapy (3, 4). The greater efficacy of this type of phototherapy is explained by the fact that the bilirubin concentration of skin increases during the interruption interval after having decreased relatively rapidly during radiance. The greater efficacy of "intermittent" phototherapy suggests that the compensation between the bilirubin concentrations in the tissue, the serum, and the skin ultimately limit the rate of elimination. Concerning the dose-response relationship, this means that an increased radiance intensity results in a relatively lower efficacy.

We do not attempt to resolve which of the two proposed presentations describes the dose-response relationship more adequately. As far as actual therapy is concerned, Tan's data, based as they are on a great number of cases, strongly suggest that a radiance intensity of approximately 2000 $\mu W/cm^2$ constitutes an optimum in the treatment of simple neonatal jaundice. This conclusion, drawn from the measured values, is by no means affected by a different type of presentation.

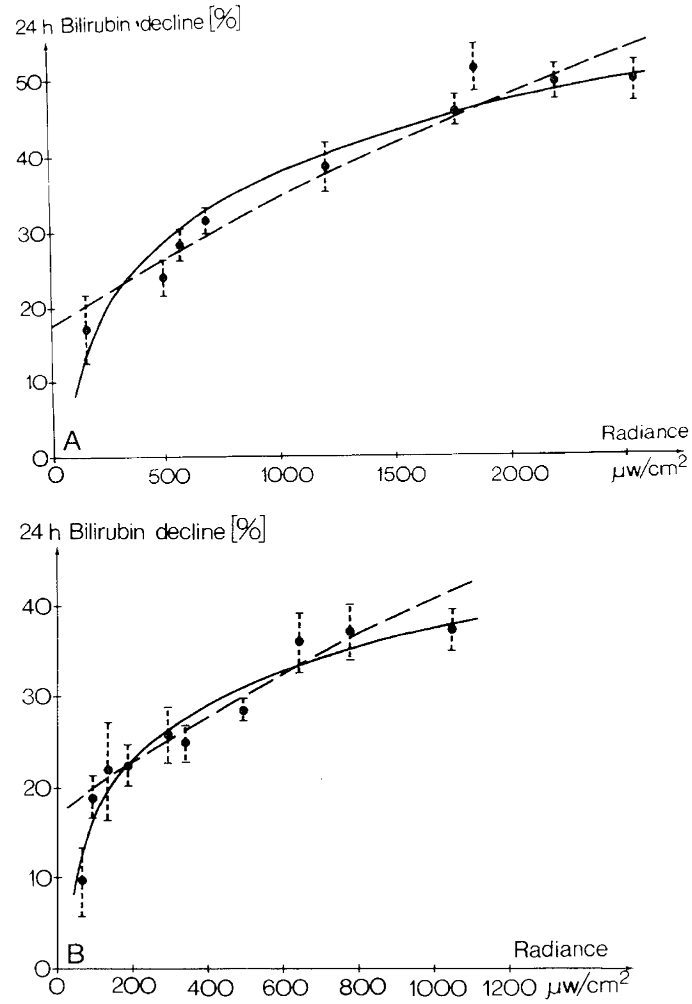

Fig. 1. The 24-hr bilirubin decline effected by increasing intensities of phototherapy as measured by Tan (1, 2). ——, calculated using Tan's empirical logarithmic functions. ---, the *e* functions derived from the model proposed by Wiese and Ballowitz (5, 6). *A*, Tan's results published in 1982. ——, $y = 29.8 \log x - 51.8$; $r = 0.97$. ---, $y = 100\,[1 - e^{-225 \cdot 10-6\,(862+x)}]$; $\tau = 0.96$. *B*, Tan's findings from 1977. ——, $y = 21.0 \log x - 25.5$; $r = 0.96$. ---, $y = 100\,[1 - e^{337 \cdot 10-6\,(567.6+x)}]$; $\tau = 0.91$.

REFERENCES AND NOTES

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