SINGLE CELL AGAINST MULTICELL HYPOTHESES OF TUMOR FORMATION

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Certain passages of the preceding paper by Linder [2] suggest the question whether tumors such as leiomyomas always emerge from one single cell or whether they may have their origin in several cells. On the face of it, the evidence presented strongly supports the single cell hypothesis. It is not my intention to dispute this; it may be interesting, however, to see that a phenomenon like the one described by Linder could also be explained by a chance mechanism. The point is that even if every tumor starts with *both* kinds of cells present, the chance mechanism that we describe would imply that large tumors containing both types of cells would be very rare.

A model frequently used to describe the growth of a population of cells is that of a birth and death process. Here the number of cells present at time t is a random variable $X(t)$. Given $X(t) = n$, the following changes may occur within a subsequent short time interval of length τ:

(i) a birth, that is, $X(t + \tau) = n + 1$, with probability $\lambda_n\tau + o(\tau)$,
(ii) a death, that is, $X(t + \tau) = n - 1$, with probability $\mu_n\tau + o(\tau)$,
(iii) other changes, with probability $o(\tau)$,

where λ_n, μ_n are nonnegative numbers and where $o(\tau)/\tau$ tends to zero as $\tau \to 0$. A birth and death process will be called linear if $\lambda_n = \lambda n$ and $\mu_n = \mu n$.

This model has been extended by Reuter [5] to describe the simultaneous development of two populations allowing for interaction, for example, competition, between the different populations. For the present purpose, however, a very particular case of his general scheme will be sufficient.

Thus, let us assume that two populations develop independently, each one according to a linear birth and death process. Denote their sizes by $A(t)$ and $B(t)$. Then we want to study the conditional probability

$$P\{A(t) > 0, B(t) > 0 | A(t) + B(t) \geqq N\}, \tag{1}$$

the condition $A(t) + B(t) \geqq N$ reflecting the fact that we consider only tumors large enough to be detected and included in the study. Since, apparently, either one of the two cell types can be detected only if it is present in at least a certain proportion, say α, (according to [2] α is between 0.05 and 0.15), we may consider instead

$$P\{A^*(t) \geqq \alpha, B^*(t) \geqq \alpha | A(t) + B(t) \geqq N\}, \tag{2}$$