Mathematical modeling of prostate cancer to personalize intermittent androgen suppression

Yoshito Hirata
Institute of Industrial Science, The University of Tokyo yoshito@sat.t.u-tokyo.ac.jp

Koichiro Akakura
Tokyo Kosei Nenkin Hospital

Celestia S. Higano
Department of Medicine, University of Washington and Fred Hutchinson Cancer Research Center

Nicholas Bruchovsky
Vancouver Prostate Centre

Kazuyuki Aihara
Institute of Industrial Science, The University of Tokyo

We propose a mathematical model of prostate cancer under intermittent androgen suppression so that we can personalize the treatment schedule. Intermittent androgen suppression [1] is a protocol that attempts to delay the relapse of disease. We start hormone therapy by monitoring a tumor marker called prostate specific antigen (PSA) every 4 weeks. If PSA decreases sufficiently, hormone therapy is stopped and PSA is monitored every 4 weeks. Therapy is resumed when PSA increases to a certain threshold. It is then stopped and restarted repeatedly to potentially delay disease relapse. The problem encountered with intermittent androgen suppression is that the effects depend on the patient: it works well for some patients but not for others. We have been attempting to overcome this problem by mathematically modeling the dynamics of prostate cancer. Our most recent model [2, 3, 4, 5] reproduces the behavior of PSA, classifies patients according to their parameters fitted to their PSA data, and predicts the future values of PSA. This approach not only helps to select patients who will benefit from intermittent androgen suppression but also serves as a guide to the ideal treatment schedule for each patient to achieve the maximum relapse free survival.

References


