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Game theory and cancer

Yannick VIOSSAT
PSL, Université Paris-Dauphine

Résumé.I will discuss some recent uses of game-theoretical ideas in mathematical models of cancer. In particular the incorporation of evolutionary dynamics modeling the interaction between different kinds of cells within a tumor. An example is adaptive-therapy for metastatic castrate-resistant prostate cancer (Zhang J, Cunningham JJ, Brown JS, Gatenby RA. Integrating evolutionary dynamics into treatment of metastatic castrate-resistant prostate cancer. Nat Commun. 2017 Nov; 8(1):1816). As a rough approximation, the current view is that this type of tumor is composed of three kinds of cells : androgen dependent (cells that need testosterone to develop but do not produce it), androgen producing (cells producing testosterone), and androgen independent (cells that do not need testosterone). When the third type is rare, the tumor initially responds well to Abiraterone, a drug inhibiting testosterone auto-production; but the standard treatment: continuous administration of high doses of Abiraterone, strongly selects for androgen independent cells, which are unaffected by Abiraterone, and resistance evolves. An alternative treatment currently being tested with encouraging results is to alternate phases of treatment and phases without treatment, based on the patient's response. The aim is to limit the growth of androgen dependent and androgen independent cells, without fully eliminating them, so that competition with these cells limit the development of androgen independent cells. The first clinical results are very encouraging.