On mathematically modelling prostate cancer

Research project : Study on recurrent dynamics on prostate cancer using mathematical models
Review number：2857-(8) (the ethics committee, University of Tokyo School of Medicine)

Research institute: Institute of Industrial Science, University of Tokyo
Principal investigator: Prof. Kazuyuki Aihara
Role: Data analysis

Collaborative research institutes:
Jiken University School of Medicine:
Principal investigator: Dr. Norihiro Hayashi
Role: Data acquisition, anonymization

JCHO Tokyo Shinjuku Medical Center
Principal investigator: Dr. Koichiro Akakura
Role: Data acquisition, anonymization

Department of Medicine, University of Washington
Principal investigator: Prof. Celestia S. Higano
Role: Data acquisition, anonymization

Canadian Cancer Trials Group (CCTG), Queens' University, Kingston
Principal investigator: Prof. Chris O'Callaghan
Role: Data acquisition, anonymization

Institute of Industrial Science, The University of Tokyo is the chief research institute among them.

The period of research：Between 21 December 2009 and 20 December 2019

Research participants

1. Patients of prostate cancer who had the prostatectomy at Department of Urology, Jikei University School of Medicine, between November 2001 and December 2013.
2. Patients of prostate cancer who were treated by intermittent hormone therapy at the Tokyo Kosei Nenkin Hospital (current JCHO Shinjuku Medical Center) between March 1999 and July 2010.
3. Patients of prostate cancer who joined the phase II trial of NCT00223665 and were treated by intermittent androgen suppression at Department of Medicine, University of Washington and its related hospitals between April 1995 and August 2011.
4. Patients of prostate cancer who joined the phase III trial of PR7 for intermittent androgen suppression at Queen's University and its collaborative hospitals between February 1999 and July 2010.
5. Patients of prostate cancer who joined the phase II trial and were treated by intermittent androgen suppression at Vancouver General Hospital and their related hospitals between June 1995 and September 2001.

Meaning and Purpose of this research

Prostate specific antigen (PSA) is known widely to be useful as a tumor marker of prostate cancer, while PSA is being shown as useful for diagnosing or prognosing the recurrence of prostate cancer. By PSA, prostate cancer can be diagnosed at its early stage, and the number of cases for early prostate cancer detected through health checkups is increasing. By following this tendency, treatments for prostate cancer have been diversified, and thus it is necessary to choose a treatment option which suits each individual patient.

In the past, the medical doctor used a single value of PSA for diagnosing or prognosing the recurrence of prostate cancer. However, recently, it has been reported that using some values of PSA is superior to using a single value of PSA in diagnosing or prognosing. Thus, to enhance the clinical merit for the PSA values, we test the temporal changes and tendency for PSA using a mathematical model and aim at constructing a simple mathematical model that can be used at an actual clinical setting, i.e, in a medical doctor's office.

Method of research

We examine whether we predict the temporal changes of PSA, metastasis, or castration resistance based of measurements of PSA and/or testosterone by using and/or revising a mathematical model of prostate cancer such as Ideta et al., J. Nonlinear Sci. 2008 and Hirata et al., J. Theor. Biol. 2010.

This research was approved by the ethics committee, University of Tokyo School of Medicine, and has been conducted under the authorization of the dean of University of Tokyo School of Medicine. This research uses the pieces of information down below, collected during the medical examinations. The patients do not have to pay the additional costs by themselves.

Provided data

The datasets that have been provided to us include PSA values, testosterone values, clinical and/or pathological stages, the existence of cancer cells at the surgical sections, the age of patients, the Gleason score, and the existence of metastasis, and all pieces of information are anonymized before we received them.

On receiving the datasets
Jikei University School of Medicine：We received the datasets via mail by CD until 14 July 2014.
Tokyo Kosei Nenkin Hospital： We received the datasets by hands in Tokyo using a USB memory until 11 November 2012.
University of Washington: We received the all the information by email until 16 March 2012.
Queen's University: We received the major parts of the datasets by hands in Tokyo using a USB memory on 13 December 2013. We received the additional datasets on metastasis until 22 January 2016 via email.
Vancouver General Hospital : We received the datasets by hands at Vancouver until 26 May 2007 using a USB memory.

We use the above datasets for the purpose of this research only, namely, to validate the temporal changes and tendency of PSA using a mathematical model and construct a simple mathematical model that can be applied in an actual clinical setting.

Protection of personal information

Although we analyze and preserve your information and data in our laboratory, the personal information including your name, address, and the date of birth had been removed. Instead, a code name has been assigned to you so that we cannot know whose information or data we have. In addition, we store your information and data with computers which are locked with passwords. But, if necessary, we can ask the hospital you received your treatments, and restore your name from this code name.

The results on this project will be published, for example, in research papers or talks in conferences so that each individual patient participating this project cannot be identified. The collected data will be stored for 5 years after the end of this project under strict control. If you are interested in the results for the project as a statistical summary, please make a contact using the information down below: we will disclose the results. If you have something you want to know, please let us know.

The costs of this research is covered by
- the subsidy for our running cost for Aihara Lab, Institute of Industrial Science, The University of Tokyo,
- the Aihara Innovative Mathematical Modelling Project, the Japan Society for the Promotion of Science (JSPS) through the “Funding Program for World-Leading Innovative R&D on Science and Technology (FIRST Program),” initiated by the Council for Science and Technology Policy (CSTP),
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- the Japan Society for the Promotion of Science (JSPS) KAKENHI Kiban S.

Among those who conduct this research, Kazuyuki Aihara, Yoshito Hirata and Kai Morino are faculties in the divisions supported by private companies. But, we ensure that we will treat and analyze the datasets fairly, most importantly independently from the companies.

To conduct this research, we are managing the conflicts of interests appropriately by reporting them to the COI advisory board, University of Tokyo School of Medicine. We do not pay anything to the participating patients.

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