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Seminar article

New concepts of biobanks—strategic chance for uro-oncology

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Abstract

Cancer, as well as other common diseases, is a complex condition that not only causes a major threat to human health, but also represents a huge burden to society in terms of healthcare cost and loss of economic productivity. Treatment improvements remain elusive, since the causes of cancer are due to a huge number of small and possibly additive effects arising from genetic susceptibility, lifestyle, and environmental conditions. Thus, progress in translational cancer research investigating these changes and their complex interaction is highly dependent on large series of cases (affected and unaffected individuals) including high quality samples and their associated data. Therefore, large and well-organized biobanks have been established, are underway, or are planned in many countries and institutions. The integration of these resources with powerful molecular and "omics" approaches, integrated bioinformatic tools hold the promise to further advance our knowledge of disease development, thus leading to better prevention and treatment strategies. However, these valuable and irreplaceable collections typically suffer from underutilization, due to fragmentation of the collections and their accessibility, lack of common management strategies, including consensus on standard operating procedures, unique policies of utilization, and distribution as well as missing input on a broad basis reflecting research needs on an interdisciplinary, multi-institutional fashion beyond project-driven interest. The uro-oncologic community has not yet contributed to these efforts to its full potential, and broad knowledge on the contemporary developments in the field of biobanking and input into these efforts are still missing. This review presents an overview on biobanking and may serve as an update to be integrated into future discussions on managing biobanks involving uro-oncology. It is based on the discussions at the last meeting of the International Bladder Cancer Network in Barcelona (Spain) in fall 2008 and has been also largely influenced by the works and discussions of the Marble Arch International Working Group on Biobanking for Biomedical Research.

Keywords: Biorepositories; Biobanking; Bladder cancer; Uro-oncology

Introduction

In the past, the majority of so-called Biobanks "run" by urologists were pure collections of samples, ideally collected prospectively with a minimum of quality control measures and annotated clinical and pathological data. In some places, these mono-institutional efforts also involve the local Department of Pathology and a research unit more or less stringent affiliated to the Department of Urology and/or Pathology. In addition, many collections were or still are developed in relation to a specific research question. This implies a much focused (and thus limited) strategy and demand on quality and annotation of the collected samples.

This resulted in very heterogeneous concepts of biobanking—not only among urologists. Considering exclusively human samples-related banks for research, and specifically for the purpose of this review only focusing on collections related to uro-oncologic research, there are multiple designs according to the different possible and valid goals. This leads to a huge number of incomprehensive and often incomparable collections.

As a prerequisite to discuss the role of the urologist in these concepts, the provision of a brief summary introducing major types of human-samples driven biobanks appears to be necessary (see also Fig. 1):

1. The ultimate goal of population-based biorepositories is to enable researchers to obtain information on determinants of susceptibility and population identity. Mostly to date their operational substrate is germline DNA from a huge number of healthy donors, representative of a specific country/region or ethnic cohort

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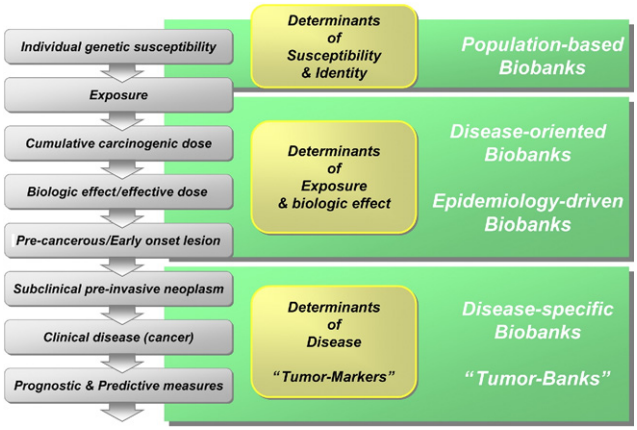

Fig. 1. Relation between disease development, type of research focusing on biological or clinical determinants, and type of biorepository relevant to the developmental stage (acc. to [49]). (Color version of figure is available online.)

[1]. The Icelandic database and its repository [2], the UK Biobank [3], or the Netherlands or Sweden Twin Registers [4,5] may serve as examples for such large collections.

2. The activity of disease-oriented biorepositories for epidemiologic-driven collections is focused on determinants of exposure (including environmental or occupational aspects), biological monitoring (mostly using huge numbers of samples following a healthy exposed cohort/case-control design), and studying germline DNA, serum and/or urine markers or environmental probes (i.e., soil, water, air, or nutrients). The vast majority of these collections are designed with a focus on very specific questions requiring detailed collected data or protocols for the collection and annotation of probes/samples. Among these collections are examples such as the European Prospective Investigation into Cancer and Nutrition (EPIC) collection having recruited over half a million (520,000) people in 10 European countries hosted by the International Agency for Research on Cancer (IARC) [6], the Spanish Bladder Cancer Network [7], or specific projects on environmental risk factors like the HiWATE [8].
3. Biorepositories, with inherent collections of samples and data related to specific diseases including cancer (often referred as "tumor banks" as a relict of our former limited understanding of biological collections) encompass prospective and/or retrospective collections of disease and non-disease samples and their derivates (DNA/RNA/proteins). The goals of such biorepositories correspond to the search for determinants of a given disease including its biological behavior through associated clinical data. In some cases, these collections are associated to clinical trials. However, the majority of the collections are not collected for a specific research project. Thus, measures of quality control vary significantly, since at the time of the collection, specific conditions are not as elaborate as they might have been under a certain project in the future. Especially with regards to the follow-up of certain conditions, these collections may often only rely on healthcare records with all its implications on completeness and quality.

This type of banking, not related to a specific research project, is especially useful in oncology research: it allows to promote and execute retrospective projects with a suitable follow-up of patients and healthy donors. To maintain the collection of an informative follow-up over a long period is especially important for some cancer types like superficial low grade bladder cancer or lymph node negative infiltrative carcinoma of breast, where a minimum of 10 years follow-up is needed.

With that, there are some collections and their collaborative structures, which may help to understand and exemplify further attempts for improvement, also with regards to the development of similar approaches and concepts within the uro-oncologic community. Among these are collections such as the A. C. Camargo Hospital Tumor Bank (ACCTB) comprising over 10,000 non-tumor and tumor samples [9], the EUROCORD registry of clinical results of cord blood transplantation [10], the European Human Tumor Frozen Tissue Bank (centralizing information on frozen tumor tissues to facilitate the search of investigators for tumor tissues for cancer research) [11], the National Cancer Institute Office of Biorepositories and Biospecimen Research [12], the National Cancer Institute of Canada Clinical Trials Group (aiming with its collection to facilitate assessment of prognostic and predictive factors, and to facilitate the understanding of the basic biological and genetic mechanisms of cancer) [13], the Canadian Tumor Repository Network (CTRNet) (a not-for-profit Canadian company, funded by Canadian Institutes of Health Research, facilitating cancer research through extensive networking activities) [14], national networks in Spain [15], Wales, [16], Republic of Ireland [17], and Singapore [18], among others.

All these efforts have inherent properties and aspects in common, which by far exceed the majority of concepts as conceived and performed by urologists or other single-discipline driven collections in the past. Thus, it appears to be necessary to discriminate and develop a deeper knowledge and recognition of differences and specific characteristics of the various biobanks and their future challenges. With comprehensive research needed for prevention as well as better care for those who have acquired challenges to their health, significant progress implies that human samples need to be sourced from distinct forms of biobanks. Since easier access to these samples for the scientific community is considered as the main bottleneck for research for health, those who are involved in the development of concepts and strategic management of biorepositories are the most appropriate to try to resolve this issue [19].