

## Review

# New Therapeutic Perspectives in Prostate Cancer: Patient-Derived Organoids and Patient-Derived Xenograft Models in Precision Medicine

Vittoria Rago <sup>1,\*</sup> , Anna Perri <sup>2</sup>  and Silvia Di Agostino <sup>3,\*</sup> 

- <sup>1</sup> Department of Pharmacy, Health and Nutritional Sciences, University of Calabria, 87036 Rende, Italy  
<sup>2</sup> Department of Experimental and Clinical Medicine, Magna Graecia University, 88100 Catanzaro, Italy; anna.perri@unicz.it  
<sup>3</sup> Department of Health Sciences, Magna Graecia University of Catanzaro, 88100 Catanzaro, Italy  
\* Correspondence: vittoria.rago@unicz.it (V.R.); sdiagostino@unicz.it (S.D.A.)

**Abstract:** One of the major goals in the advancement of basic cancer research focuses on the development of new anticancer therapies. To understand the molecular mechanisms of cancer progression, acquired drug resistance, and the metastatic process, the use of preclinical in vitro models that faithfully summarize the properties of the tumor in patients is still a necessity. The tumor is represented by a diverse group of cell clones, and in recent years, to reproduce in vitro preclinical tumor models, monolayer cell cultures have been supplanted by patient-derived xenograft (PDX) models and cultured organoids derived from the patient (PDO). These models have proved indispensable for the study of the tumor microenvironment (TME) and its interaction with tumor cells. Prostate cancer (PCa) is the most common neoplasia in men in the world. It is characterized by genomic instability and resistance to conventional therapies. Despite recent advances in diagnosis and treatment, PCa remains a leading cause of cancer death. Here, we review the studies of the last 10 years as the number of papers is growing very fast in the field. We also discuss the discovered limitations and the new challenges in using the organoid culture system and in using PDXs in studying the prostate cancer phenotype, performing drug testing, and developing anticancer molecular therapies.

**Keywords:** prostate cancer; patient-derived organoid (PDO); patient-derived xenograft (PDX); precision medicine; targeted therapy



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## 1. Introduction

Prostate cancer (PCa) is the most commonly diagnosed malignancy and the second leading cause of death in males [1,2]. Risk factors for this condition include older age, family history, obesity, hypertension, sedentary lifestyle, high testosterone levels, and ethnicity [3]. There are generally no initial or early symptoms, but late symptoms may include renal failure from ureteral obstruction, anemia, bone pain, and paralysis from spinal metastases.

The primary diagnosis is made by prostate-specific antigen (PSA) testing, although the use of this test for screening remains controversial [4]. On the other hand, ultrasound-guided transrectal prostate tissue biopsies (TRUS) are significant [5]. The latest diagnostic tests include the prostate cancer gene3 (PCA3) urine test, measurement of free and total PSA levels, prostate health index (PHI) score, 4K score/multiparametric magnetic resonance imaging (4K/MRI test), exosome test, genomic analysis, magnetic resonance imaging (MRI), the prostate imaging-reporting and data system (PIRADS), and prostate biopsy using MRI fusion techniques [6]. When cancer is localized, it is considered curable; when it spreads outside the prostate, treatment approaches include hormone treatment, chemotherapy, radiopharmaceuticals, immunotherapy, pain medications, bisphosphonates, rank ligand inhibitors, focused radiation, and other targeted therapies [7]. The effects of these therapies

# New Perspectives In Prostate Cancer

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## **New Perspectives In Prostate Cancer:**

*New Perspectives in Prostate Cancer* Arie Belldégrun, Professor Tim Oliver, Roger S Kirby, Donald W W Newling, 1998-03-01 A summary of the highlights of the Second International Forum on Prostate Cancer held in Cambridge in 1998 The contributors include scientists epidemiologists and clinicians who provide both a North American and a European view of treatment The patient s perspective is also considered **New Perspectives in Prostate Cancer, Second Edition**

Arie Belldégrun, Professor Tim Oliver, Roger S Kirby, Donald W W Newling, 2000-03-01 A large portion of the text is devoted to the treatment of localized and advanced prostate cancer **New Perspectives in Prostate Cancer** Arie

Belldégrun, Professor Tim Oliver, Roger S Kirby, Donald W W Newling, 1998-03-01 A summary of the highlights of the Second International Forum on Prostate Cancer held in Cambridge in 1998 The contributors include scientists epidemiologists and clinicians who provide both a North American and a European view of treatment The patient s perspective is also considered

**Inhibitors of CDK family: New Perspective and Rationale for Drug Combination in Preclinical Model of Solid Tumors** Andrea Cavazzoni, Arianna Palladini, 2023-04-25 **72nd Annual Meeting of the Italian Society of Physiology:**

**New Perspectives in Physiological Research** Giovanna Valenti, Fiorenzo Conti, Andrea Gerbino, Grazia Tamma, 2024-04-15

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*disease* Stefania Mariggiò, Maria-Bernadette Madel, Enrico Iaccino, Claudine Blin-Wakkach, 2022-12-29 Prostate Cancer

Richard G. Pestell, Marja T. Nevalainen, 2008-02-26 Award winning authors present a comprehensive review of new perspectives in prostate cancer research and open up new directions in the clinical management of prostate cancer In Prostate Cancer Signaling Networks Genetics and New Treatment Strategies the authors focus on the biology genetics molecular signaling networks in the disease process and recent advances in the treatment of prostate cancer This state of the art title provides key insights into cutting edge advances in prostate cancer research such as laparoscopic radical prostatectomy and offers a critical evaluation and discussion of opportunities for development of novel therapies for prostate cancer Clinical trials that have not been covered or evaluated in any other books currently available are also discussed Invaluable to physicians and researchers Prostate Cancer Signaling Networks Genetics and New Treatment Strategies provides a comprehensive translational resource as well as an important source of information for prostate cancer patients

**Urology & Nephrology** Bernard L Schwartz, 2002-05 PDR eMedguides are clear and concise internet navigational

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**Seminars in Nuclear Medicine**, 2007 Urology and Nephrology Alan W. Partin, 2001-03 *Anticancer Research*, 2003 **Oncology & hematology** Martin D. Abeloff, 2001 **Active Surveillance for Localized Prostate Cancer** Laurence Klotz, 2017-09-29 This fully updated and revised new edition provides a comprehensive state of the art review of this field and will serve as a valuable resource for clinicians surgeons and researchers with an interest in prostate cancer The book reviews new data about molecular characteristics of the disease profiles the new grading system for prostate cancer introduced in 2015 and provides new perspectives about imaging of prostate cancer as well as the role of targeted biopsies The text summarizes the role of biomarkers and MRI in patient selection and management and details the world wide results of active surveillance Specific chapters address communication and ethical issues QOL outcomes economic aspects and psycho social aspects of surveillance The role of focal therapy for low risk disease is summarized and the data supporting preventive interventions during surveillance reviewed This text will serve as a very useful resource for physicians and researchers dealing with and interested in this common malignancy as it provides a concise yet comprehensive summary of the current status of the field that will help guide patient management and stimulate investigative efforts

**Knobil and Neill's Physiology of Reproduction** Ernst Knobil, 2006 The 3rd edition the first new one in ten years includes coverage of molecular levels of detail arising from the last decade's explosion of information at this level of organismic organization There are 5 new Associate Editors and about 2/3 of the chapters have new authors Chapters prepared by return authors are extensively revised Several new chapters have been added on the topic of pregnancy reflecting the vigorous investigation of this topic during the last decade The information covered includes both human and experimental animals basic principles are sought and information at the organismic and molecular levels are presented The leading comprehensive work on the physiology of reproduction Edited and authored by the world's leading scientists in the field Is a synthesis of the molecular cellular and organismic levels of organization Bibliographies of chapters are extensive and cover all the relevant literature

**Renal, Bladder and Prostate Cancer, An Update** Karl H. Kurth, Gerald H. Mickisch, F. H. Schröder, 1999 This is an advanced reference and clinical text documenting the latest advances and current knowledge on all aspects of diagnosing and treating renal bladder and prostate cancer It contains 33 original new chapters by high level experts in urology oncology endocrinology immunohematology and pathology from leading medical centers in the United States and Europe Their contributions provide essential updates on today's most intensely researched and debated issues in renal bladder and prostate cancer These include molecular genetics organ sparing surgery tumor nephrectomy metastatic renal cell carcinoma

gene therapy optimal strategies for early detection accuracy of grading avoiding aggressive treatment when unneeded advances in radiotherapy minimal invasive treatment alternatives endocrine treatment androgen monotherapy quality of life issues new approaches to drug development intravesical chemotherapy adjuvant therapy urinary cytokines as predictors bladder preservation orthotopic urinary diversion systemic treatment and contemporary approaches for chemotherapy

Massively referenced and fully indexed      **Prostate Cancer** Konstantinos N. Syrigos, 2001 Worldwide prostate cancer is rising by 3% annually and is a major cause mortality There are many unresolved issues concerning prostate cancer such as the benefits of screening and management in the elderly This book will be a definitive reference including the changes in use of combined androgen blockades which have had an impact on clinical practice in the last 18 months and new developments in implant radiation hormone therapy and laser conagulation There are chapters on clinical trials and meta analyses and the social and economic burden of prostate cancer      **Prostate Cancer** Marja T. Nevalainen, M.D. Ph.D., 2008-04 Award winning authors present a comprehensive review of new perspectives in prostate cancer research and open up new directions in the clinical management of prostate cancer In **Prostate Cancer Signaling Networks Genetics and New Treatment Strategies** the authors focus on the biology genetics molecular signaling networks in the disease process and recent advances in the treatment of prostate cancer This state of the art title provides key insights into cutting edge advances in prostate cancer research such as laparoscopic radical prostatectomy and offers a critical evaluation and discussion of opportunities for development of novel therapies for prostate cancer Clinical trials that have not been covered or evaluated in any other books currently available are also discussed Invaluable to physicians and researchers **Prostate Cancer Signaling Networks Genetics and New Treatment Strategies** provides a comprehensive translational resource as well as an important source of information for prostate cancer patients      **Ultrasound of the Prostate** Matthew D. Rifkin, 1997 Dr Rifkin s definitive volume on ultrasound of the prostate has now been expanded into a complete guide to diagnosis and treatment of prostate disease using all current imaging modalities ultrasound now including color Doppler computed tomography magnetic resonance imaging radionuclide studies and other modalities The Second Edition thoroughly examines the disease processes that are diagnosable by imaging studies explains the diagnostic capabilities and limitations of each imaging modality and offers expert guidance in selecting performing and interpreting imaging studies Complementing the text are 1 097 illustrations including 69 in full color that demonstrate the various imaging procedures and depict both normal and pathologic findings The book includes detailed discussions of the clinical indications for imaging and suggested patient workups      **Gynecologic and Urologic Pathology** Maria Rosaria Raspollini, Antonio Lopez-Beltran, 2019-02-21 This book highlights the similarities and differences in the pathology of the genital and urinary tracts in males and females      *Manual of Clinical Oncology* Dennis Albert Casciato, Barry Bennett Lowitz, 2000 The thoroughly updated Fourth Edition of this Spiral R Manual is a practical accessible guide to the management of patients with cancer In a clear outline format designed for

rapid reference the book provides the essential information you need for fast effective clinical decision making at the bedside of patients with malignancies Coverage begins with current information on nuclear medicine radiation oncology chemotherapeutic agents and supportive care Subsequent chapters focus on specific solid tumors and hematologic malignancies and on complications resulting from local invasion metastases paraneoplasia or treatment Appendices include combination therapy regimens for Hodgkin and non Hodgkin lymphoma toxicities of chemotherapy tumor identifiers and a glossary of cytogenetic nomenclature Paperback edition available only in selected countries Please check with your local representative or distributor

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str cell 3 1 conf val 85 212 98 76 78 342 for ii 1 3 text str ii confidence num2str conf val ii 0 2f end define the positions and colors of the text boxes

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