## BREAKING ADVANCES

### 4953

Highlights from Recent Cancer Literature

## REVIEWS

### 4955

Emerging Potential of Therapeutic Targeting of Ubiquitin-Specific Proteases in the Treatment of Cancer

Anupama Pal, Matthew A. Young, and Nicholas J. Donato

### 4967

Sonic Hedgehog Signaling in Basal Cell Nevus Syndrome

Mohammad Athar, Changzhao Li, Arianna L. Kim, Vladimir S. Spiegelman, and David R. Bickers

## PERSPECTIVE

### 4976

Obesity, Cholesterol Metabolism, and Breast Cancer Pathogenesis


## INTEGRATED SYSTEMS AND TECHNOLOGIES

### 4983

High-Throughput Time-Resolved FRET Reveals Akt/PKB Activation as a Poor Prognostic Marker in Breast Cancer

Selvaraju Veeriah, Pierre Leboucher, Julien de Naurois, Nirmal Jethwa, Emma Nye, Tamara Bunting, Richard Stone, Gordon Stamp, Véronique Calleja, Stefanie S. Jeffrey, Peter J. Parker, and Banañshe Larijani

**Précis:** Using a novel quantitative imaging platform to determine the status of an activated biomarker in cancer patients may better identify high-risk patients who could benefit from a suitable targeted drug therapy.

## MICROENVIRONMENT AND IMMUNOLOGY

### 4996

Neutralizing Murine TGFβR2 Promotes a Differentiated Tumor Cell Phenotype and Inhibits Pancreatic Cancer Metastasis

Katherine T. Ostapoff, Bercin Kutluk Cenik, Miao Wang, Risheng Ye, Xiaohong Xu, Desiree Nugent, Moriah M. Hagopian, Mary Topalovski, Lee B. Rivera, Kyla D. Carroll, and Rolf A. Brekken

**Précis:** This study demonstrates that TGFβ signaling in stromal cells directly affects tumor cell plasticity and the metastatic capacity of pancreatic tumors.

### 5008

TLR7 Promotes Tumor Progression, Chemotherapy Resistance, and Poor Clinical Outcomes in Non–Small Cell Lung Cancer

Saradiya Chatterjee, Lucie Crozet, Diane Damotte, Kristina Iribarren, Catherine Schramm, Marco Alifano, Audrey Lupo, Julien Cherfils-Vicini, Jeremy Goc, Sandrine Katsahian, Mohammad Younes, Marie Caroline Dieu-Nosjean, Wolf Herman Fridman, Catherine Sautès-Fridman, and Isabelle Cremer

**Précis:** Activation of an immune stimulatory molecule, TLR7, studied mainly in immune cells but also highly expressed in human lung carcinoma cells, confers powerful tumor growth advantage that may be mediated in part by NFκB, perhaps helping explain its contributions to cancer.

### 5019

Optimal Effector Functions in Human Natural Killer Cells Rely upon Autocrine Bone Morphogenetic Protein Signaling

Neil C. Robson, Laura Hidalgo, Tristan McAlpine, Heng Wei, Victor G. Martínez, Ana Estrena, Gustavo J. Melen, Andrew S. MacDonald, Alexander Phythian-Adams, Rosa Sacedón, Eugene Maraskovsky, Jonathan Cebon, Manuel Ramírez, Angeles Vicente, and Alberto Varas

**Précis:** The TGFβ superfamily members BMP-2 and BMP-6 are produced by and are required to support the optimal functions of natural killer immune cells, suggesting new ways to enhance the powerful capability of these cells to eradicate tumors.

### 5032

Stress Signaling from Human Mammary Epithelial Cells Contributes to Phenotypes of Mammographic Density

Rosa Anna DeFilippis, Colleen Fordyce, Kelley Patton, Hang Chang, Jianxin Zhao, Gerald V. Fontenay, Karla Kerlikowske, Bahram Parvin, and Thea D. Tlsty

**Précis:** These findings provide new insights into how high mammographic density arises in the breast and why this condition is associated with breast cancer risk, with implications for the definition of novel invention targets to prevent breast cancer.

### 5045

Molecular Homology and Difference between Spontaneous Canine Mammary Cancer and Human Breast Cancer

Deli Liu, Huan Xiong, Angela E. Ellis, Nicole C. Northrup, Carlos O. Rodriguez Jr, Ruth M. O’Regan, Stephen Dalton, and Shaying Zhao

**Précis:** This study of spontaneous mammary cancers that arise in dogs offers a novel perspective on critical questions in breast cancer research.
5057 CSF1/CSF1R Blockade Reprograms Tumor-Infiltrating Macrophages and Improves Response to T-cell Checkpoint Immunothersy in Pancreatic Cancer Models
Yu Zhu, Brett L. Knolhoff, Melissa A. Meyer, Timothy M. Nywening, Brian L. West, Jingqin Luo, Andrea Wang-Cilliam, S. Peter Goedegebuure, David C. Linehan, and David G. DeNardo
Précis: These preclinical findings offer a rationale to empower therapeutic effects of T-cell checkpoint-based immunotherapeutics that block PD-1 and CTLA-4 by reprogramming of immunosuppressive myeloid cells that are abundant in the tumor microenvironment.

5070 Macrophage Inflammatory Protein Derivative ECI301 Enhances the Alarmin-Associated Abscopal Benefits of Tumor Radiotherapy
Shiro Kanegasaki, Kouji Matsushima, Kenshiro Shiraiishi, Keiichi Nakagawa, and Tomoko Tsuchiya
Précis: This study suggests mechanistic insights into a long recognized but little understood phenomenon in radiotherapy, the abscopal effect, which refers to antitumor benefits outside the irradiated field.

5079 Natural Killer Cells Eradicate Galectin-1–Deficient Glioma in the Absence of Adaptive Immunity
Gregory J. Baker, Peter Chockley, Viveka Nand Yadav, Robert Doherty, Michael Ritt, Sivaraj Sivaramakrishnan, Maria G. Castro, and Pedro R. Lowenstein
Précis: Blocking an important mechanism of immune escape in glioma mediated by galectin-1 overexpression may be sufficient to restore the ability of natural killer cells to eradicate this type of brain cancer, without the need of adaptive immune functions.

Molecular and Cellular Pathobiology

5091 BMP4 Inhibits Breast Cancer Metastasis by Blocking Myeloid-Derived Suppressor Cell Activity
Yuan Cao, Clare Y. Slaney, Bradley N. Bidwell, Belinda S. Parker, Cameron N. Johnstone, Jai Rautela, Bedrich L. Eckhardt, and Robin L. Anderson
Précis: This study demonstrates that BMP4 can inhibit metastasis by reducing NF-κB activity in tumor cells, leading to a suppression of G-CSF secretion and a consequent reduction in the number of metastases promoting myeloid-derived suppressor cells.

5103 A Novel Wnt Regulatory Axis in Endometrioid Endometrial Cancer
Yu Zhao, Yihua Yang, Jone Trovik, Kun Sun, Liang Zhou, Peiyong Jiang, Tat-San Lau, Erling A. Hoivik, Helga B. Salvesen, Hao Sun, and Huating Wang
Précis: These findings establish a novel Wnt/β-catenin regulatory axis that involves a tumor suppressive member of the cadherin family, protocadherin-10, and a noncoding RNA, MALAT1, that supports the development of a subtype of endometrial cancer.

5118 Natural Allelic Variations in Glutathione Peroxidase-1 Affect Its Subcellular Localization and Function
Soumen Bera, Frank Weinberg, Dede N. Ekoue, Kristine Aarsenberger-Fricano, Mao Mao, Marcelo G. Bonini, and Alan M. Diamond
Précis: Genetic variations in glutathione peroxidase-1 that affect the risk of several types of cancer are shown here to affect the function of this enzyme, with implications for understanding its fundamental roles in cancer pathophysiology.

5127 TIGAR Has a Dual Role in Cancer Cell Survival through Regulating Apoptosis and Autophagy
Jia-Ming Xie, Bin Li, Hong-Pei Yu, Quan-Geng Gao, Wei Li, Hao-Rong Wu, and Zheng-Hong Qin
Précis: These results illuminate a new mechanism by which a key inhibitor of cell death helps regulate the response of cancer cells to chemotherapeutic drugs, with possible implications as a drug response biomarker.

5139 Validation and Structural Characterization of the LEDGF/p75–MLL Interface as a New Target for the Treatment of MLL-Dependent Leukemia
Kateřina Cermáková, Petr Tesina, Jonas Demeuilemeester, Sara El Ashkar, Hélène Méreau, Juerg Schwaller, Pavlina Rezáčová, Vaclav Veverka, and Jan De Rijck
Précis: This study identifies a potential molecular foothold in epigenetic therapy aimed at altering transcriptional programs in cancer cells to selectively trigger their demise.
Armed Oncolytic Virus Enhances Immune Therapy

Toni M. Brand, Mari Iida, Andrew P. Stein, Kelsey L. Corrigan, Cara M. Braverman, Neha Luthar, Mahmoud Toulany, Parkash S. Gill, Ravi Salgia, Randall J. Kimple, and Deric L. Wheeler

Preciso: This preclinical study provides a rationale to target the oncogenic receptor kinase AXL in cancers that exhibit intrinsic or acquired resistance to the anti-EGFR drug cetuximab, with immediate implications for the clinical evaluation of AXL inhibitors in cetuximab-resistant cancers.

RPA Inhibition Increases Replication Stress and Suppresses Tumor Growth

Jason G. Glanzer, Shengjin Liu, Ling Wang, Adam Mosel, Aimin Peng, and Greg C. Oakley

Preciso: By targeting a lynchpin of DNA replication, a compound that heightens DNA replication stress in cancer cells may offer a broadly useful new strategy for treatment.

HSV-sr39TK Positron Emission Tomography and Suicide Gene Elimination of Human Hematopoietic Stem Cells and Their Progeny in Humanized Mice

Eric H. Gschwend, Melissa N. McCracken, Michael L. Kaufman, Michelle Ho, Roger P. Hollis, Xiaoayan Wang, Nadeep Saini, Richard C. Koya, Thineh Chodon, Antoni Ribas, Owen N. Witte, and Donald B. Kohn

Preciso: These results support the clinical development of a dual use imaging-suicide gene in immunotherapy and provide insights into the reversible engraftment of human hematopoietic stem cells.

Quantitative Optical Imaging of Primary Tumor Organoid Metabolism Predicts Drug Response in Breast Cancer

Alex J. Walsh, Rebecca S. Cook, Melinda E. Sanders, Luigi Aurisicchio, Gennaro Ciliberto, Carlos L. Arteaga, and Melissa C. Skala

Preciso: This study demonstrates that cellular-level optical imaging of metabolic coenzymes resolves early, heterogeneous drug responses within primary tumor organoid cultures that are consistent with long-term in vivo tumor response.

Armed Oncolytic Virus Enhances Immune Functions of Chimeric Antigen Receptor–Modified T Cells in Solid Tumors

 Nobuhiro Nishio, Jula Dtaconu, Hao Liu, Vincenzo Cerullo, Ignazio Caruana, Valentina Hoyos, Lisa Bouchier-Hayes, Barbara Savoldo, and Gianpietro Dotti

Preciso: The cytokine/chemokine-armed virus described in this report may improve the effectiveness of CAR T-cell therapy in solid tumors, where this therapy has not been nearly as effective as in liquid tumors.
miR149 Functions as a Tumor Suppressor by Controlling Breast Epithelial Cell Migration and Invasion
Annabell Bischoff, Bettina Huck, Bettina Keller, Michaela Strotbek, Simone Schmid, Melanie Boerries, Hauke Busch, Dafne Müller, and Monilola A. Olayioye
Précis: These findings define the molecular function of miR-149, which is downregulated in aggressive and often untreatable basal-like breast cancers, with potential implications for the design of future miRNA-based therapeutics in this disease setting.

RB Family Tumor Suppressor Activity May Not Relate to Active Silencing of E2F Target Genes
Tinke L. Vormer, Kamila Wojciechowicz, Marleen Dekker, Sandra de Vries, Anja van der Wal, Elly Delzenne-Goette, Sjalin H. Naik, Ji-Ying Song, Jan-Herman Dannenberg, Jacob B. Hansen, and Hein te Riele
Précis: These provocative findings suggest that RB tumor suppressor activity does not require interaction with LxCxE-containing proteins, implying it may not involve silencing of E2F target genes as previously thought.

Runx2 Is a Novel Regulator of Mammary Epithelial Cell Fate in Development and Breast Cancer
Précis: These results establish a novel function for Runx2 of mammary cell fate and breast cancer that may offer a novel generalized route for therapeutic interventions in this malignancy.

Ubiquitin-like Protein FAT10 Promotes the Invasion and Metastasis of Hepatocellular Carcinoma by Modifying β-Catenin Degradation
Rongfa Yuan, Kai Wang, Junwen Hu, Chen Yan, Ming Li, Xin Yu, Xiaxia Liu, Jun Lei, Wuhua Guo, Linquan Wu, Kui Hong, and Jianghua Shao
Précis: These findings link two drivers of invasion and metastasis in liver cancer and identify a novel pathway for β-catenin control that may have relevance in other cancers.

Cell Surface Lactate Receptor GPR81 Is Crucial for Cancer Cell Survival
Christina L. Roland, Thiruvengadam Arumugam, Defeng Deng, Shi He Liu, Bincy Philip, Sobeyda Gomez, William R. Burns, Vijaya Ramachandran, Huanmin Wang, Zobeida Cruz-Monserrate, and Craig D. Logsdon
Précis: Lactate metabolic changes alter cancer cell survival, and this study suggests a highly targetable G-protein coupled receptor on the cancer cell surface as a novel generalized antimetabolic therapy cancer treatment.

TALEN-Mediated Somatic Mutagenesis in Murine Models of Cancer
Shuyuan Zhang, Lin Li, Sara L. Kendrick, Robert D. Gerard, and Hao Zhu
Précis: These results document new methods of interrogating cancer genes, advancing genome editing to study somatic mutations in vivo.

Intestinal Epithelial HuR Modulates Distinct Pathways of Proliferation and Apoptosis and Attenuates Small Intestinal and Colonic Tumor Development
Antonina Giammanco, Valerie Blanc, Grace Montenegro, Ceen Klos, Yan Xie, Susan Kennedy, Jianyang Luo, Sung-Hee Chang, Timothy Hla, Il-Ke Nalbantoglu, Sekhar Dharmarajan, and Nicholas O. Davidson
Précis: These results provide novel insight into the role of the ubiquitous RNA binding protein HuR as an oncogenic modifier of colon tumor susceptibility.

Genetic Ablation of Metadherin Inhibits Autochthonous Prostate Cancer Progression and Metastasis
Liling Wan, Guohong Hu, Yong Wei, Min Yuan, Roderick T. Bronson, Qifeng Yang, Javed Siddiqui, Kenneth J. Pienta, and Yibin Kang
Précis: A poorly understood gene that is overexpressed widely in human cancer is shown to support malignant progression, providing a foundation to justify studies that could elucidate its molecular function and potential as a therapeutic target.

Correction
Correction: Enhancing Reproducibility in Cancer Drug Screening: How Do We Move Forward?
ABOUT THE COVER

Non-invasive in vivo imaging of gene-modified human hematopoietic stem cells and their progeny can be achieved using positron image tomography (PET), shown here as coronal and sagittal plane overlays on X-ray computed tomography scans. Imaging after systemically administered \([\text{F}^18]\)-FHBG reveals accumulation of probe localized to areas of hematopoietic engraftment such as the humerus, tibia, femur, vertebrae, sternum, and thymus. Background probe uptakes in the gastrointestinal tract and gall bladder, present in non-humanized NSG and mock-transduced humanized mice have been artificially masked for clarity. For details, see article by Gschwend on page 5173.