BIOGRAPHICAL SKETCH

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NAME: Michael J. Caterina, M.D., Ph.D.

eRA COMMONS USER NAME (credential, e.g., agency login): mcateri

POSITION TITLE: Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Pennsylvania State Univ., University Park, PA	B.S.	05/1987	Biology
Johns Hopkins School of Medicine, Baltimore, M	M.D.	06/2005	Medicine
Johns Hopkins School of Medicine, Baltimore, MD	Ph.D.	06/2005	Biochemistry, Cellular and Molecular Biology
University of California, San Francisco, San Francisco, CA	postdoc	08/99	Pain Biology

A. Personal Statement

For twenty two years, I have been studying the mechanisms underlying pain sensation in the mouse. During my postdoctoral work, I cloned and characterized Transient Receptor Potential Vanilloid 1 (TRPV1), the ion channel receptor for capsaicin and a sensor of painfully hot temperatures. Since starting my own lab in 1999, we have continued to focus on the contributions of TRPV ion channels to pain and temperature sensation, the molecular basis of TRPV channel activation, and the contribution of skin keratinocytes to pain. We have also studied the molecular and cellular mechanisms underlying neuropathic pain in transgenic mice and the mechanisms underlying pain in models of hereditary palmoplantar keratodermas. I serve as Director of the Neurosurgery Pain Research Institute at Johns Hopkins and as Interim Director of the Department of Biological Chemistry. For ten years, I Co-Directed the Graduate Program in Biological Chemistry, and I have mentored numerous undergraduate students, PhD students, postdoctoral fellows, and junior faculty. I am affiliated with five different PhD programs. I am therefore fully dedicated to professional development of scientists-in-training.

B. Positions and Honors

1987-1995 NIH Medical Scientist Training Program Award
1988 Franklin Paine Mall Award in Anatomy and Cell Biology
1995-1996 Postdoctoral Fellowship, U.C.S.F. Cardiovascular Research Institute
1996-1999 Postdoctoral Fellowship, American Cancer Society
1996-1998 Young Investigator Award, National Alliance For Research on Schizophrenia and Depression
1999-2004 Assistant Professor of Biological Chemistry, Johns Hopkins School of Medicine
1999-2004 Assistant Professor of Neuroscience, Johns Hopkins School of Medicine
2000 Keith Killam Memorial Award in Receptor Pharmacology, Western Pharmacology Society
2001 - date NIH Ad hoc reviewer: SEP ZRG1 IFCN-5 (03), National Cancer Institutes Subcommittee C, SEP 2005/01 ZRG1 IFCN-K (02) (M), NSDC Study Section, Neurogenesis and Cell Fate Study Section, Limited Competition for Dietary Supplement Research Centers: Botanicals, ZRG1 MDCN-D 02 M, ZRG1 MDCN-N, SEP Cluster Review Panel 10/08, Mol. Cell. Dev. Neurosc. IRG 4/09, Cell and Tissue Oncology SEP 10/09, Neurotoxicology and Alcohol (NAL) Study Section 3/10, NIDCD ZDC1 SRB-Y 51 3/11, NTRC study section 9/11 , IAM meeting 2012/05 ZRG1 IFCN-L (02) M 2/12, 139 TRA 2013_IRG 1/13, SEP ZDA1 JXR-G (01) 5/14, SEP ZRG1 CB-P 8/14**,** ZRG1 ETTN-M 6/15 and 3/16, ZRG1 IFCN-B (03) M 10/15, 10/16, ZRG1 ETTN-

A (11) 11/17, ACTS Study Section 10/18, SPS Study Section 2/19, ZRG1 IFCN-N 55 R 2/19, New Innovator Award Program 1/16, 12/16, 12/17, 12/18, NIH Intramural Reviews for NIDCR and NIDDK.
2001 Searle Scholars Award
2001 Beckman Young Investigator Award
2001 W. M. Keck Foundation Distinguished Young Scholar in Medical Research
2001 NARSAD Freedman Award Honorable Mention
2003 Peter E. Dresel Memorial Lecture in Pharmacology, Dalhousie University, Halifax, Nova Scotia
2003-date Grant Reviewer for Programs that have included: Wellcome Foundation Postdoctoral Fellowships, Blaustein Pain Research Foundation, International Association for the Study of Pain, American Pain Society, Beckman Young Investigator Program
2003-2013 Co-Director, Biological Chemistry Graduate Program, Johns Hopkins Sch. Medicine
2004-2018 Deputy Editor, Molecular Pain
2004-2010 Associate Professor of Biological Chemistry and Neuroscience, Johns Hopkins School of Medicine
2005 Patrick D. Wall Young Investigator Award, International Association for the Study of Pain
2007 Principle Speaker, Keratinocyte Study Group of Japan
2007-date Member, Johns Hopkins Center for Sensory Biology
2007-2012 Associate Editor, Journal of Neuroscience
2008-2010 Program Committee, Society for Neuroscience
2008 Professor's Award for Excellence in Teaching, Johns Hopkins School of Medicine
2009 Program Committee, International Association for the Study of Pain
2010-date Professor of Biological Chemistry, Johns Hopkins School of Medicine
2010-date Professor of Neuroscience, Johns Hopkins School of Medicine
2013 Donlin M. Long Pain Service Award, Blaustein Pain Research Program, Johns Hopkins Sch. Medicine
2013-date Professor of Neurosurgery, Johns Hopkins School of Medicine
2013 Inaugural Director, Neurosurgery Pain Research Institute at Johns Hopkins Sch. Medicine
2014 Inaugural Solomon H. Snyder Professor of Neurosurgery
2015 Julius B. Kahn Lectureship Guest Speaker, Northwestern School of Medicine
2018-date Interim Director, Department of Biological Chemistry, Johns Hopkins School of Medicine

C. Contributions to Science

1) Cloning and characterization of TRPV1, a capsaicin- and painful heat-gated nonselective cation channel expressed predominantly in a subpopulation nociceptive sensory neurons. My colleagues and I also generated TRPV1 knockout mice and demonstrated that this channel is entirely responsible for behavioral and physiological responses to capsaicin and related vanilloid compounds, and is a partial contributor to heat-evoked pain perception. Our work helped to usher in a new era of pain research that incorporates molecular genetics techniques to selectively visualize, functionally characterize, and manipulate nociceptive neurons.

Caterina, M.J., Schumacher, M., Tominaga, M.,, Rosen, T.A., Levine, J.D. and Julius, D. (1997) The capsaicin receptor, a heat-activated ion channel in the pain pathway Nature, 389, 816-824. (cover article)

Tominaga, M., **Caterina, M.J.**, Malmberg, A.B., Rosen, T.A., Gilbert, H., Skinner, K., Raumann, B.E., Basbaum, A.I. and Julius, D. (1998) The cloned capsaicin receptor integrates multiple pain-producing stimuli. Neuron, 21, 531-543. (cover article)

Caterina, M.J., Leffler, A., Malmberg, A., Martin,W., Trafton, J., Petersen-Zeitz, K.R., Koltzenberg, M., Basbaum,A. and Julius, D. (2000) Impaired nociception and pain sensation in mice lacking the capsaicin receptor. Science 288, 306-313. (cover article)

Caterina, M.J., Julius, D. The vanilloid receptor: a molecular gateway to the pain pathway. (2001) Ann. Rev. Neurosci. 24, 487-517.

2) Cloning and characterization of the TRPV1 homolog, TRPV2. This heat-gated cation channel is also expressed in a subpopulation of sensory neurons. However, our subsequent generation and characterization of TRPV2 knockout mice demonstrated that this channel is not a major contributor to thermal or mechanical pain. However, it does turn out to be required for perinatal survival, via mechanisms that remain unclear. We have also studied potential roles for this channel in macrophage biology.

Caterina, M.J., Rosen, T.A., Tominaga, M., Brake, A.J., and Julius, D. (1999) A capsaicin receptor homologue with a threshold for noxius heat. Nature, 398, 436-441.

Link TM, Park U, Vonakis BM, Raben DM, Soloski MJ, **Caterina MJ.** TRPV2 has a pivotal role in macrophage particle binding and phagocytosis Nature Immunology (2010) 11, 232-239. PMID: 20118928

Park U, Vastani N, Guan Y, Raja S, Koltzenberg M. and **Caterina MJ** (2011) TRPV2 knockout mice are susceptible to perinatal lethality but display normal thermal and mechanical nociception J Neurosci. 31(32):11425-36. PMID: 21832173

3) Physiological characterization of TRPV3 and TRPV4. We discovered that TRPV4 is a warmth-gated ion channel expressed strongly in skin keratinocytes. We also discovered 2-APB as the first known chemical agonist for another warmth-gated channel, TRPV3. We went on to show for the first time that skin keratinocytes express functional ion channel responses mediated by these channels. This work provided some of the first hints that skin keratinocytes might participate in peripheral sensory function.

Guler, A., Lee, H., Iida, T., Shimizu, I. Tominaga, M., and **Caterina, M.** Heat-evoked activation of the ion channel, TRPV4 (2002) J. Neurosci. 22, 6408-6414.

Chung, M.K., Lee, H. and **Caterina, M.J.** Warm Temperatures Activate TRPV4 in Mouse 308 Keratinocytes (2003) J. Biol. Chem. 278, 32037-32046

Chung M.K., Lee H., Mizuno A., Suzuki M., **Caterina M.J.** TRPV3 and TRPV4 mediate warmth-evoked currents in primary mouse keratinocytes. (2004) J Biol. Chem. 279, 21569-21575.

Chung M.K., Lee H., Mizuno A., Suzuki M., **Caterina M.J.** 2-aminonethoxydiphenyl borate activates and sensitizes the heat-gated ion channel, TRPV3 (2004) J. Neurosci. 24, 5177-5182.

4) In vivo examination of the roles of keratinocytes in peripheral pain and temperature sensation. Using a range of transgenic mouse approaches, we have provided evidence that skin keratinocytes are direct participants in nociception and thermosensation. This has been achieved through the examination of mice either overexpressing or lacking heat-gated TRPV channels. We have also shown that a keratinocyte-based painful disorder, pachyonychia congenita, exhibits neuropathic anatomical features.

Lee, H., Iida, T., Mizuno, A., Suzuki, M., **Caterina M.J.** Altered thermal preference in mice lacking TRPV4 (2005) J. Neurosci. 25 1304-1310.

Pang Z, Sakamoto T, Kim YS, Yang F, Guan Y, Dong X, Guler A, **Caterina MJ**. Keratinocyte stimulation is sufficient to evoke nociception in the mouse (2015) *Pain* 2015 Apr;156(4):656-65. PMID: 25790456 (cover article)

Pan, B., Byrnes, K., Schwartz, M., Hansen, C.D., Campbell, C., Krupiczojc, M., **Caterina, M.J.**, and Polydefkis, M. (2016) Peripheral neuropathic changes in Pachyonychia Congenita *Pain* Dec;157(12):2843-2853.PMID: 27776012(cover article)

Weinberg, R.L., Polydefkis, M., Coulombe, P.A., and **Caterina, M.J.** Pain mechanisms in hereditary palmoplantar keratodermas (*In Press, British Journal of Dermatology*) PMID:30883689

5) Discovery of agonist-dependent ionic selectivity in TRPV ion channels. We demonstrated that TRPV1 and TRPV3 exhibit an agonist-dependent increase in their permeability to large cations, concomitant with more complex changes in calcium permeability. By taking advantage of the published TRPV1 structure, we applied molecular modeling to provide a plausible biophysical explanation for the gain- and loss-of-function phenotypes exhibited by channels mutated in this process.

Chung M.K., Guler A.D., and **Caterina M.J.** (2005) Biphasic currents evoked by chemical or thermal activation of the heat-gated ion channel, TRPV3. J. Biol Chem. 280, 15928-15941.

Chung M.K., Guler A.D. and **Caterina M.J.** (2008) TRPV1 exhibits dynamic ionic selectivity during agonist stimulation Nature Neuroscience 11, 555-564. (Highlighted in Nat Neurosci. 2008 May;11(5):528-9)

Munns CH, Chung MK, Amzel LM, and **Caterina MJ.** (2015) Role of the outer pore domain in TRPV1 dynamic permeability to large cations. J. Biol Chem. 290: 5707-5724.

A more extensive list of publications can be found at
http://www.ncbi.nlm.nih.gov/myncbi/collections/bibliography/46573367/?reload=publicURL

D. Additional Information: Research Support and/or Scholastic Performance

Ongoing
7/1/2018-4/30/2022
NIH 1R01NS103974 (MPI Caterina, Meffert)
Role of a conserved miRNA regulatory axis in neuropathic pain
Role: MPI (Administrative contact)

NIAMS 1R01AR072230-01 (PI Qu)
8/6/17-6/30/22
A novel mechanism of rheumatoid arthritis-associated pain
Role: Co-Investigator

NIDCR 1 R01 DE027731-01 (Multi PI Chung, Wang)
9/1/18-6/30/23
Primary afferent plasticity in chronic pain
Role: Co-Investigator

Completed past 3 yrs
2014-2018 NIDCR RO1DE023846 (PI Chung)
Genetic and posttranslational modifications of TRPV1 in craniofacial pain
Role: Co-investigator

8/1/12 – 6/30/17
NIDCR 1R01DE022750-01
Neuronal subtype-specific plasticity in the acute to chronic pain transition
Role: Principal Investigator (Multi-PI Caterina, Dong, Ginty)

09/01/2015 – 06/30/2017
3R01DE022750-04S1
Role: Advisor
Diversity Supplement to : Neuronal subtype-specific plasticity in the acute to chronic pain transition