

## BIOGRAPHICAL SKETCH

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NAME <b>Gregory W. Terman</b>	POSITION TITLE Professor		
eRA COMMONS USER NAME gregterman			
EDUCATION/TRAINING <i>(Begin with baccalaureate or other initial professional education, such as</i>			
INSTITUTION AND LOCATION	DEGREE <i>(if applicable)</i>	YEAR(s)	FIELD OF STUDY
College of William and Mary; Williamsburg, Va.	B.S.	1980	Psychology
University of California, Los Angeles, Ca.	Ph.D.	1985	Behavioral Neuroscience
University of Miami, Miami, Fla.	M.D.	1987	Medicine
University of Washington, Seattle, Wa.	Fellowship	1992-4	Pharmacology

### A. Positions and Honors.

#### Positions and Employment

1983-84	Research Assistant, Department of Psychology, University of California, Los Angeles (J.C. Liebeskind, Ph.D. Thesis advisor)
1984	Visiting Pre-doctoral Fellow, Department of Pharmacology, Australian National University (A.W. Duggan, Laboratory P.I.)
1987-88	Intern, Internal Medicine, University of Washington, Seattle, WA
1988-91	Resident, Anesthesiology, University of Washington, Seattle, WA
1991-92	Clinical Fellow, Multidisciplinary Pain Center, University of Washington, Seattle, WA
1992-94	NRSA Fellow/Acting Clinical Instructor, Anesthesiology, University of Washington, Seattle, WA
1993-94	Adjunct Acting Clinical Instructor, Department of Pharmacology, University of Washington, Seattle, WA (C. Chavkin, Laboratory P.I.)
1994-99	Assistant Professor, Department of Anesthesiology, University of Washington, Seattle, WA
1998-99	Assistant Professor, Graduate Program in Neurobiology and Behavior, University of Washington, Seattle, WA
2000-09	Associate Professor, Department of Anesthesiology, University of Washington, Seattle, WA
2000-09	Associate Professor, Graduate Program in Neurobiology and Behavior, University of Washington, Seattle, WA
2002-	Affiliate Investigator, Fred Hutchinson Cancer Research Center, Seattle, WA
2009-	Professor, Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, WA
2009-	Professor, Graduate Program in Neurobiology and Behavior, University of Washington, Seattle, WA
2009-	Director of Pain Research, Department of Anesthesiology and Pain Medicine, University of Washington, Seattle, WA

### B. Selected peer-reviewed publications (in chronological order).

- Terman, G.W., Lewis, J.W., and Liebeskind, J.C.: Opioid and nonopioid mechanisms of stress analgesia: Lack of cross-tolerance between stressors. *Brain Res.* 260:147-150, 1983.
- Terman, G.W., Shavit, Y., Lewis, J.W., Cannon, J.T., and Liebeskind, J.C.: Intrinsic mechanisms of pain inhibition and their activation by stress. *Science* 226:1270-1277, 1984.
- Moskowitz, A.S., Terman, G.W., and Liebeskind, J.C.: Stress-induced analgesia in the mouse: strain comparisons. *Pain* 23:67-72, 1985.

- Terman, G.W., Penner, E.R., and Liebeskind, J.C.: Stimulation-produced and stress-induced analgesia: Cross-tolerance between opioid forms. *Brain Res.* 360:374-378, 1985.
- Foong, F.W., Terman, G.W., and Duggan, A.W.: Methysergide and spinal inhibition from electrical stimulation in periaqueductal grey. *Eur. J. Pharmacol.* 116:239-248, 1985.
- Terman, G.W., Lewis, J.W., and Liebeskind, J.C.: Two opioid forms of stress analgesia: Studies of tolerance and cross-tolerance. *Brain Res.* 368:101-106, 1986.
- Terman, G.W., Morgan, M.J., and Liebeskind, J.C.: Opioid and nonopioid stress analgesia from cold water swim: Importance of stress severity. *Brain Res.* 372:167-171, 1986.
- Pechnick, R.N., and Terman, G.W.: The role of opiate receptors in the potentiation of pentobarbital sleeping time by the acute and chronic administration of opiates. *Neuropharmacology* 26:1589-1593, 1987.
- Wagner, J.J., Terman, G.W., and Chavkin, C.: Endogenous dynorphins inhibit excitatory neurotransmission and block LTP induction in the hippocampus. *Nature*, 363:451-454, 1993.
- Terman, G.W., Wagner, J.J., and Chavkin, C.: Endogenous and exogenous kappa opioids inhibit induction of long-term potentiation in the dentate gyrus of the guinea pig hippocampus. *J. Neurosci.* 14:4740-4741, 1994.
- Drake, C.T., Terman, G.W., Simmons, M.L., Milner, T.A., Kunkel, D.D., Schwartzkroin, P.A., and Chavkin, C.: Dynorphin opioids present in dentate granule cells may function as retrograde inhibitory neurotransmitters. *J. Neurosci.* 14:3736-3750, 1994.
- Simmons, M.L., Terman, G.W., Drake, C.T., and Chavkin, C.: Inhibition of glutamate release by presynaptic kappa opioid receptors in the guinea pig dentate gyrus. *J. Neurophysiol.* 72:1697-1705, 1994.
- Simmons, M.L., Terman, G.W., Gibbs, S.M., and Chavkin, C.: L-type calcium channels mediate dynorphin neuropeptide release from dendrites but not axons of hippocampal granule cells. *Neuron* 14:1265-1274, 1995.
- Rapp, S.E., Egan, K.J., Ross, B.K., Wild, L.M., Terman, G.W., and Ching, J.M.: Multidimensional comparison of morphine and hydromorphone patient controlled analgesia. *Anesth. Analg.* 82:1043-1048, 1996.
- Jin, W., Terman, G.W., and Chavkin, C.: Kappa opioid receptor tolerance in the guinea pig hippocampus. *J. Pharmacol Exp Therap*, 281: 123-128, 1997.
- Simmons, M.L., Terman, G.W., and Chavkin, C.: Spontaneous excitatory currents and kappa opioid receptor inhibition in dentate gyrus are increased in the rat pilocarpine model of temporal lobe epilepsy. *J. Neurophysiology*, 78:1860-1868, 1997.
- Bausch, S.B., Esteb, T.M., Terman, G.W., Chavkin, C.: Administered and endogenously released kappa opioids decrease pilocarpine-induced seizures and seizure-induced histopathology: *J. Pharmacol. Exp. Therap.*, 284:1147-1155, 1998.
- Terman, G.W., Drake, C.T., Simmons, M.L., Milner, T.A. and Chavkin, C.: Opioid modulation of recurrent excitation in the hippocampal dentate gyrus, *J Neurosci.*, 20:4379-4388, 2000.
- Rogalski, S.L., Appleyard, S., Patillo, A., Terman, G.W., Chavkin, C.: Growth factor signalling can be mediated by Ion Channel Phosphorylation, *J. Bio. Chem.*, 275:25082-8, 2000.
- Varnado-Rhodes, Y., Gunther, J., Terman, G.W., Chavkin, C.: Mu-opioid analgesia and analgetic tolerance in two different mouse strains: C57BL/6 and 129/SvJ mice. *Proc. West. Pharmacol. Soc.*, 43: 15-17, 2000.
- Jin, W., Assi, A.-A., Eastman, C., Terman, G.W., Chavkin, C.: Synaptic plasticity contributes to opioid tolerance *in vitro*, *Soc. Neurosci. Abstr.*, 26: 636, 2000.
- Terman, G.W., Jin, W., Gunther, J., Caron, M., Lefkowitz, R., Chavkin, C.: G-protein coupled receptor kinase (GRK3) mediates mu opiate analgesic tolerance, *Soc. Neurosci. Abstr.*, 26: 112, 2000.
- Terman, G.W. and Bonica, J.J.: Anatomic and Physiologic Basis of Nociception: Spinal Mechanisms and Their Modulation, in Loeser, J, Butler, S, Chapman, R, and Turk, D, (Eds.): *Bonica's Management of Pain.* Pp. 73-153. New York, Williams and Wilkins, 2000.
- Terman, G.W., Eastman, C.L. and Chavkin, C.: Mu opiates inhibit LTP induction in the spinal cord slice, *J. Neurophysiology*, 85: 485-494, 2001.
- Terman, G.W., Jin, W., Cheong, Y-P, Caron, M.G., Lefkowitz, R.J. and Chavkin, C.: G-Protein receptor kinase 3 (GRK3) mediates analgesic tolerance but not withdrawal, *British Journal of Pharmacology*, 141:55-64, 2004.
- Xu, M., Petraschka, M., McLaughlin, J.P., Westenbroek, R.E., Caron, M.G., Lefkowitz, R.G., Czyzyk, T.A., Pintar, J.E., Terman, G.W. and Chavkin, C.: Neuropathic Pain Activates the Endogenous Kappa Opioid

System in Mouse Spinal Cord and Induces Opioid Receptor Tolerance. *J.Neurosci.*, 24: 4576-4584, 2004.

Sullivan M, Terman GW, Peck B, Correll DJ, Rich B, Clark WC, Latta K, Lebovits A, Gebhart G; American Pain Society Ethics Committee: APS position statement on the use of placebos in pain management. *J Pain*. 2005 Apr;6(4):215-7.

Thomson LM, Zeng J, Terman GW.: An N-methyl-D-aspartate receptor mediated large, low-frequency, spontaneous excitatory postsynaptic current in neonatal rat spinal dorsal horn neurons. *Neuroscience*. 2006 Sep 1;141(3):1489-501.

Thomson LM, Zeng J, Terman GW.: Differential effect of glutamate transporter inhibition on EPSCs in the morphine naive and morphine tolerant neonatal spinal cord slice. *Neurosci Lett*. 2006 Oct 16;407(1):64-9.

Zeng J, Thomson LM, Aicher SA, Terman GW. : Primary afferent NMDA receptors increase dorsal horn excitation and mediate opiate tolerance in neonatal rats. *J Neurosci*. 2006 Nov 15;26(46):12033-42.

Thomson, LM, Terman, GW, Zeng, J, Lowe, J, Chavkin, C, Hermes, SM, Hegarty, DM and Aicher, SA: Decreased Substance P and NK1 receptor immunoreactivity and function in the spinal cord dorsal horn of morphine-treated neonatal rats. *J Pain*, 9:11-19, 2008.

Grande, LA, O'Donnell, B, Fitzgibbon, D, Terman GW: Ultra-low Dose Ketamine and Memantine for the Treatment of Complex Pain in an Opioid-Tolerant Oncology Patient, *Anesthesia and Analgesia*, 107:1380-3, 2008.

Eastman, CL., Zeng, J, Cheong, PY and Terman, GW: Kappa opioids modulate Lamina I neurotransmission in morphine- tolerant but not in morphine-naïve spinal slices, submitted.

Terman, GW: Kappa opioids inhibit neurotransmission in Lamina I of the spinal cord following sensitization, submitted.

### **C. Research Support.**

#### **Ongoing Research Support**

Investigator Initiated Trial (NAM-MD-63) Terman, G.W. (PI) 2/1/09-1/31/11

Forest Research Institute

Memantine for Post-Operative Pain Control

Based on our previous studies in rodents and our own clinical case studies this clinical study will evaluate the effects of the oral NMDA receptor antagonist in treating post-operative and inflammatory pain in the peri-operative period in both opiate naïve and opiate tolerant patients. There is no overlap in specific aims with the current proposal.

Role: Principal Investigator

R21 DA025842-01 Terman, G.W. (PI) 06/01/09 – 05/31/11

NIH/NIDA

Modulation of Pruritus by Spinal Cannabinoids.

This project investigates the mechanisms underlying scratching behaviors seen in rats following intrathecal administration of CB1 antagonists and the dramatic potentiation of this scratching in the opiate tolerant rat. There is no overlap in specific aims with the current proposal.

Role: Principal Investigator

#### **Completed Research Support (Last 3 years)**

Life Sciences Discovery Grant Mourad P. (PI) 8/08-7/09

Life Sciences Discovery Fund

Transcutaneous Acoustic Palpation: Sensitivity and Specificity

Human studies directed towards development of a non-invasive way of determining the specific sources of pain. This collaborative project between investigators from industry, anesthesiology, radiology and neurosurgery is aimed at developing a non-invasive ultrasound-based method for assessing pain generators deep to the skin of patients that could be adapted for human diagnostic purposes. This grant funds initial studies in human volunteers using this approach. There is no overlap in specific aims with the current proposal.

Role: Co-Investigator

R21 CA118334-02 Shen, D.D. (PI) 05/01/06 – 04./30/09  
NIH/NCI

Modulation of Opioid Effects by Garlic Supplements.

This project investigates pharmacokinetic interactions between garlic supplements and two mu-opioids - oxycodone and fentanyl. Pharmacodynamic consequences of these intreractions will also be assessed. There is no overlap in specific aims with the current proposal.

glycoprotein in healthy volunteers.

Role: Co-investigator

Merit Review VA Grant Kliot M. (PI) 1/1/05-12/31/08

Veterans Administration

Ultrasound palpation to safely evaluate tissue pathology.

Animal studies directed towards development of a non-invasive way of determining the specific sources of pain. This collaborative project between investigators from industry, anesthesiology, radiology and neurosurgery is aimed at developing a non-invasive ultrasound-based method for assessing pain generators deep to the skin of animals that could be adapted for human diagnostic purposes. This grant looks at neuropathic models of pain.

Role: Co-Investigator

R21 AT002712 Shen, D.D (PI) 04/01/05 – 03/31/08  
NIH/NCCAM

Garlic Metabolism and Cytochrome P450 Modulation

This project investigates how short-term and long-term treatments with three commonly used garlic preparations (dried powder, garlic oil and aged garlic) affect the functions of cytochrome P450 enzymes and P-glycoprotein in healthy volunteers.

Role: Co-Investigator

R01 DA014588 Terman (PI) 02/01/03 – 01/31/07  
NIH/NIDA

Modulation of Spinal Cord LTP by Kappa Opioids.

Principal Investigator: Gregory Terman MD, PhD

Intense nociceptive stimuli can produce a central sensitization to later noxious stimulation in both laboratory animals and man. We have recently developed a model of such sensitization (LTP) in the spinal cord slice preparation and found that both exogenous and endogenous kappa opiates inhibit LTP maintenance or expression mechanisms. The studies supported by this grant further investigate the mechanisms by which kappa opiates inhibit LTP maintenance or expression preferentially in vitro and in vivo.

Role: Principal Investigator