



Alban Latremoliere

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## DEMOGRAPHIC AND PERSONAL INFORMATION

### Current Appointment

2017-present Assistant Professor, Department of Neurosurgery

### Personal Data

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Baltimore, MD 21205

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### Education and Training

2003-2007	Doctorate	Université Pierre et Marie Curie (UPMC – Paris VI ; France)
2008-2010	Postdoc	Harvard Medical School & Massachusetts General Hospital, Boston, MA
2010-2017	Postdoc	Harvard Medical School & Boston Children’s Hospital, Boston, MA

### Professional Experience

2002-2003	Undergraduate, Lab of Pr. Michel Hamon, Université Pierre et Marie Curie (Paris VI ; France)
2003-2007	Graduate Student, Lab of Pr. Michel Hamon, Université Pierre et Marie Curie (Paris VI ; France)
2008-2010	Postdoctoral fellow, Lab of Dr. Clifford J. Woolf, Harvard Medical School/MGH, Boston MA
2010-2017	Postdoctoral fellow. Lab of Dr. Clifford J. Woolf, Harvard Medical School/BCH, Boston MA
2017- present	Assistant Professor, Department of Neurosurgery, Johns Hopkins University School of Medicine

### PUBLICATIONS:

\*: *co-first author*

- 1- Meunier, A., **Latremoliere, A\***, Mauborgne, A., Bourgoin, S., Kayser, V., Cesselin, F., Hamon, M., and Pohl, M. (2005). Attenuation of pain-related behavior in a rat model of trigeminal neuropathic pain by viral-driven enkephalin overproduction in trigeminal ganglion neurons. *Mol Ther* 11, 608-616. [OR]
- 2- Doucet, E., **Latremoliere, A.**, Darmon, M., Hamon, M., and Emerit, M.B. (2007). Immunolabelling of the 5-HT 3B receptor subunit in the central and peripheral nervous systems in rodents. *Eur J Neurosci* 26, 355-366. [OR]
- 3- Meunier, A., **Latremoliere, A.**, Dominguez, E., Mauborgne, A., Philippe, S., Hamon, M., Mallet, J., Benoliel, J.J., and Pohl, M. (2007a). Lentiviral-mediated Targeted NF-kappaB Blockade in Dorsal Spinal Cord Glia Attenuates Sciatic Nerve Injury-induced Neuropathic Pain in the Rat. *Mol Ther* 15, 687-697. [OR]

- 4- **Latremoliere, A.**, Mauborgne, A., Masson, J., Bourgoin, S., Kayser, V., Hamon, M., and Pohl, M. (2008). Differential implication of proinflammatory cytokine interleukin-6 in the development of cephalic versus extracephalic neuropathic pain in rats. *J Neurosci* 28, 8489-8501. [OR]
- 5- Costigan, M., Moss, A., **Latremoliere, A\***, Johnston, C., Verma-Gandhu, M., Herbert, T.A., Barrett, L., Brenner, G.J., Vardeh, D., Woolf, C.J., and Fitzgerald, M. (2009). T-cell infiltration and signaling in the adult dorsal spinal cord is a major contributor to neuropathic pain-like hypersensitivity. *J Neurosci* 29, 14415-14422. [OR]
- 6- **Latremoliere, A.**, and Woolf, C.J. (2009). Central sensitization: a generator of pain hypersensitivity by central neural plasticity. *J Pain* 10, 895-926. [RA]
- 7- Kayser, V., Viguier, F., Ioannidi, M., Bernard, J.F., **Latremoliere, A.**, Michot, B., Vela, J.M., Buschmann, H., Hamon, M., and Bourgoin, S. (2010). Differential anti-neuropathic pain effects of tetrodotoxin in sciatic nerve- versus infraorbital nerve-ligated rats—behavioral, pharmacological and immunohistochemical investigations. *Neuropharmacology* 58, 474-487. [OR]
- 8- **Latremoliere, A.**, and Woolf, C.J. (2010). Synaptic plasticity and central sensitization: author reply. *J Pain* 11, 801-803. [RA]
- 9- Kayser, V., **Latremoliere, A.**, Hamon, M., and Bourgoin, S. (2011). N-methyl-D-aspartate receptor-mediated modulations of the anti-allodynic effects of 5-HT1B/1D receptor stimulation in a rat model of trigeminal neuropathic pain. *Eur J Pain* 15, 451-458. [OR]
- 10- **Latremoliere, A.**, and Costigan, M. (2011). GCH1, BH4 and pain. *Curr Pharm Biotechnol* 12, 1728-1741. [RA]
- 11- Ma, C.H., Omura, T., Cobos, E.J., **Latremoliere, A.**, Ghasemlou, N., Brenner, G.J., van Veen, E., Barrett, L., Sawada, T., Gao, F., Coppola, G., Gertler, F., Costigan, M., Geschwind, D., and Woolf, C.J. (2011). Accelerating axonal growth promotes motor recovery after peripheral nerve injury in mice. *J Clin Invest* 121, 4332-4347. [OR]
- 12- Costigan, M., **Latremoliere, A.**, and Woolf, C.J. (2012). Analgesia by inhibiting tetrahydrobiopterin synthesis. *Curr Opin Pharmacol* 12, 92-99. [RA]
- 13- Painter, M.W., Brosius Lutz, A., Cheng, Y.C., **Latremoliere, A.**, Duong, K., Miller, C.M., Posada, S., Cobos, E.J., Zhang, A.X., Wagers, A.J., Havton, L.A., Barres, B., Omura, T., and Woolf, C.J. (2014). Diminished Schwann cell repair responses underlie age-associated impaired axonal regeneration. *Neuron* 83, 331-343. [OR]
- 14- Belin, S., Nawabi, H., Wang, C., Tang, S., **Latremoliere, A.**, Warren, P., Schorle, H., Uncu, C., Woolf, C.J., He, Z., and Steen, J.A. (2015). Injury-induced decline of intrinsic regenerative ability revealed by quantitative proteomics. *Neuron* 86, 1000-1014. [OR]
- 15- **Latremoliere, A.**, Latini, A., Andrews, N., Cronin, S.J., Fujita, M., Gorska, K., Hovius, R., Romero, C., Chuaiphichai, S., Painter, M., Miracca, G., Babaniyi, O., Remor, A.P., Duong, K., Riva, P., Barrett, L.B., Ferreiros, N., Naylor, A., Penninger, J.M., Tegeder, I., Zhong, J., Blagg, J., Channon, K.M., Johnsson, K., Costigan, M., and Woolf, C.J. (2015). Reduction of Neuropathic and Inflammatory Pain through Inhibition of the Tetrahydrobiopterin Pathway. *Neuron* 86, 1393-1406. [OR]
- 16- Nawabi, H., Belin, S., Cartoni, R., Williams, P.R., Wang, C., **Latremoliere, A.**, Wang, X., Zhu, J., Taub, D.G., Fu, X., Yu, B., Gu, X., Woolf, C.J., Liu, J.S., Gabel, C.V., Steen, J.A., and He, Z. (2015). Doublecortin-Like Kinases Promote Neuronal Survival and Induce Growth Cone Reformation via Distinct Mechanisms. *Neuron* 88, 704-719. [OR]
- 17- Omura, T., Omura, K., Tedeschi, A., Riva, P., Painter, M.W., Rojas, L., Martin, J., Lisi, V., Huebner, E.A., **Latremoliere, A.**, Yin, Y., Barrett, L.B., Singh, B., Lee, S., Crisman, T., Gao, F., Li, S., Kapur, K., Geschwind, D.H., Kosik, K.S., Coppola, G., He, Z., Carmichael, S.T., Benowitz, L.I., Costigan, M., and Woolf, C.J. (2015). Robust Axonal Regeneration Occurs in the Injured CAST/Ei Mouse CNS. *Neuron* 86, 1215-1227. [OR]
- 18- Vicuna, L., Strohlic, D.E., **Latremoliere, A.**, Bali, K.K., Simonetti, M., Husainie, D., Prokosch, S., Riva, P., Griffin, R.S., Njoo, C., Gehrig, S., Mall, M.A., Arnold, B., Devor, M., Woolf, C.J., Liberles, S.D., Costigan, M., and Kuner, R. (2015). The serine protease inhibitor SerpinA3N attenuates neuropathic pain by inhibiting T cell-derived leukocyte elastase. *Nat Med* 21, 518-523. [OR]
- 19- Andrews, N.A., **Latremoliere, A.\***, Basbaum, A.I., Mogil, J.S., Porreca, F., Rice, A.S., Woolf, C.J., Currie, G.L., Dworkin, R.H., Eisenach, J.C., Evans, S., Gewandter, J.S., Gover, T.D., Handwerker, H., Huang, W., Iyengar, S., Jensen, M.P., Kennedy, J.D., Lee, N., Levine, J., Lidster, K., Machin, I., McDermott, M.P., McMahon, S.B., Price, T.J., Ross, S.E., Scherrer, G., Seal, R.P., Sena, E.S., Silva, E., Stone, L., Svensson, C.I., Turk, D.C., and

- Whiteside, G. (2016). Ensuring transparency and minimization of methodologic bias in preclinical pain research: PPRECISE considerations. *Pain* 157, 901-909.
- 20- Kahle, K.T., Schmouth, J.F., Lavastre, V., **Latremoliere, A.**, Zhang, J., Andrews, N., Omura, T., Laganieri, J., Rochefort, D., Hince, P., Castonguay, G., Gaudet, R., Mapplebeck, J.C., Sotocinal, S.G., Duan, J., Ward, C., Khanna, A.R., Mogil, J.S., Dion, P.A., Woolf, C.J., Inquimbert, P., and Rouleau, G.A. (2016). Inhibition of the kinase WNK1/HSN2 ameliorates neuropathic pain by restoring GABA inhibition. *Sci Signal* 9, ra32. [OR]
- 21- Latremoliere, A. (2016). [Sepiapterin reductase as a novel target to treat neuropathic pain]. *Med Sci (Paris)* 32, 152-155. [RA]
- 22- Latremoliere, A. (2016). Spinal plasticity of the nociceptive system – the role of central sensitization in chronic pain states. In *An Introduction to Pain and Nervous System Disorders*, A. Battaglia, ed. (Wiley). [BC]
- 23- Sakuma, M., Gorski, G., Sheu, S.H., Lee, S., Barrett, L.B., Singh, B., Omura, T., **Latremoliere, A\***, and Woolf, C.J. (2016). Lack of motor recovery after prolonged denervation of the neuromuscular junction is not due to regenerative failure. *Eur J Neurosci* 43, 451-462. [OR]
- 24- Alexandre, C\*, **Latremoliere, A\***, Ferreira, A, Miracca, G, Yamamoto, M, Scammell, TE, and Woolf, CJ (2017). Decreased alertness due to sleep loss increases pain sensitivity in mice. *Nat Med* 23, 768-774. [OR]
- 25- Banno, T., Omura, T., Masaki, N., Arima, H., Xu, D., Okamoto, A., Costigan, M., **Latremoliere, A.**, Matsuyama, Y., and Setou, M. (2017). Arachidonic acid containing phosphatidylcholine increases due to microglial activation in ipsilateral spinal dorsal horn following spared sciatic nerve injury. *PLoS One* 12, e0177595. [OR]
- 26- Browne, L.E., **Latremoliere, A.**, Lehnert, B.P., Grantham, A., Ward, C., Alexandre, C., Costigan, M., Michoud, F., Roberson, D.P., Ginty, D.D., and Woolf, C.J. (2017). Time-Resolved Fast Mammalian Behavior Reveals the Complexity of Protective Pain Responses. *Cell Rep* 20, 89-98. [OR]
- 27- **Latremoliere, A.**, and Costigan, M. (2017). Combining Human and Rodent Genetics to Identify New Analgesics. *Neurosci Bull.* [RA]
- 28- Cobos, E.J., Nickerson, C.A., Gao, F., Chandran, V., Bravo-Caparros, I., Gonzalez-Cano, R., Riva, P., Andrews, N.A., **Latremoliere, A.**, Seehus, C.R., Perazzoli, G., Nieto, F.R., Joller, N., Painter, M.W., Ma, C.H.E., Omura, T., Chesler, E.J., Geschwind, D.H., Coppola, G., Rangachari, M., Woolf, C.J., and Costigan, M. (2018). Mechanistic Differences in Neuropathic Pain Modalities Revealed by Correlating Behavior with Global Expression Profiling. *Cell Rep* 22, 1301-1312. [OR]
- 29- Michoud, F., Sottas, L., Browne, L.E., Asboth, L., **Latremoliere, A.**, Sakuma, M., Courtine, G., Woolf, C.J., and Lacour, S.P. (2018). Optical cuff for optogenetic control of the peripheral nervous system. *J Neural Eng* 15, 015002. [OR]
- 30- Inquimbert P, Moll M, **Latremoliere A**, Tong CK, Whang J, Sheehan GF, Smith BM, Korb E, Athié MCP, Babaniyi O, Ghasemlou N, Yanagawa Y, Allis CD, Hof PR, Scholz J. (2018). NMDA Receptor Activation Underlies the Loss of Spinal Dorsal Horn Neurons and the Transition to Persistent Pain after Peripheral Nerve Injury. *Cell Rep*. 2018 May 29;23(9):2678-2689. [OR]
- 31- **Latremoliere A\***, Cheng L\*, DeLisle M, Wu C, Chew S, Hutchinson EB, Sheridan A, Alexandre C, Latremoliere F, Sheu SH, Golidy S, Omura T, Huebner EA, Fan Y, Whitman MC, Nguyen E, Hermawan C, Pierpaoli C, Tischfield MA, Woolf CJ, Engle EC. (2018). Neuronal-Specific TUBB3 Is Not Required for Normal Neuronal Function but Is Essential for Timely Axon Regeneration. *Cell Rep*. 2018 Aug 14;24(7):1865-1879. [OR]
- 32- Liu Y\*, **Latremoliere A\***, Li X\*, Zhang Z\*, Chen M, Wang X, Fang C, Zhu J, Alexandre C, Gao Z, Chen B, Ding X, Zhou JY, Zhang Y, Chen C, Wang KH, Woolf CJ, He Z. (2018). Touch and tactile neuropathic pain sensitivity are set by corticospinal projections. *Nature*. 2018 Sep;561(7724):547-550. [OR]
- 33- Cronin SJF, Seehus C, Weidinger A, Talbot S, Reissig S, Seifert M, Pierson Y, McNeill E, Longhi MS, Turnes BL, Kreslavsky T, Kogler M, Hoffmann D, Ticevic M, da Luz Scheffer D, Tortola L, Cikes D, Jais A, Rangachari M, Rao S, Paolino M, Novatchkova M, Aichinger M, Barrett L, **Latremoliere A**, Wirnsberger G, Lametschwandtner G, Busslinger M, Zicha S, Latini A, Robson SC, Waisman A, Andrews N, Costigan M, Channon KM, Weiss G, Kozlov AV, Tebbe M, Johnsson K, Woolf CJ, Penninger JM. (2018). The metabolite BH4 controls T cell proliferation in autoimmunity and cancer. *Nature*. 2018 Nov 7 [OR]

## FUNDING

## Current:

9/1/17-9/31/20      Sleep and pain interactions in normal and pathological states  
Startup Package  
Neurosurgery Department, Johns Hopkins University  
Role: PI; 95%

## Completed:

1/1/18-12/31/18      Optogenetic Assessment of Peripheral Nerve Regeneration  
Blaustein Pain Foundation  
Neurosurgery Department, Johns Hopkins University  
Role: PI; 5%

8/1/12-7/31/17      Sleep disturbance as a risk factor for developing chronic pain  
R01 DE022912  
NIH/NHLBI  
PI: Clifford J Woolf, Tom Scammell  
Role: Co-investigator, Postdoctoral research fellow

4/1/12-3/31/17      The mechanisms of action of T-lymphocytes in neuropathic Pain  
R01 NS074430  
NIH/NHLBI  
PI: Mike Costigan  
Role: Co-investigator, Postdoctoral research fellow

8/1/12-7/31/17      Altered Sensibility Following Peripheral Nerve Damage  
R01 NS NS038253-S1  
NIH/NHLBI  
PI: Clifford J Woolf  
Role: Co-investigator, Postdoctoral research fellow

1/1/08-12/31/09      Implication of tetrahydrobiopterin (BH4) in persistent pain states  
Fondation Pour La Recherche Medicale  
Role: PI; 100%

## Mentoring

### Pre-doctoral Advisees /Mentees

2013-2014      Giulia Miracca/Master Student  
Vita-Salute San Raffaele University, Faculty of Medicine and Surgery, Milan  
Mentored master thesis

## RESEARCH ACTIVITIES *(in chronological order, earliest first by start date under each subcategory)*

### Research Focus

My research specializes in the neurobiology of sensory systems, with an emphasis on pain and regeneration. The major goal of my research is to understand the maladaptive responses that occur after peripheral nerve injury and develop strategies to improve recovery from injury as well as reduce neuropathic pain. My main areas of research are: 1) How can we assess ongoing pain in rodent models of neuropathic pain in vivo and what are the mechanisms

responsible, 2) How does reinnervation of target tissue after peripheral nerve regeneration affect the development of chronic abnormal pain sensitivity and 3) How is sleep architecture altered in models of acute and chronic pain?

## Inventions, Patents, Copyrights

- **Patent pending:** US20170307591A1; Methods and assays relating to sepiapterin reductase inhibition. Inventors: Clifford J. Woolf; Alexandra S. LATINI; Nick A. ANDREWS; **Alban LATREMOLIERE**; Michael Costigan
- **Patent submitted (June 13<sup>th</sup>):** 62684599: BIOMARKERS OF NEUROPATHIC PAIN

## ORGANIZATIONAL ACTIVITIES

### Editorial Activities

#### Journal peer review activities

2006-now Journal peer reviewer for 27 journals including: Current Biology, EMBO reports, European Journal of neuroscience, European Journal of Pain, European Journal of Pharmacology, Experimental Neurology, Headache, Journal of Pain, Journal of sleep medicine, PLOS one, Sleep.

## RECOGNITION

### Awards, Honors

2003 Fellowship of the French Minister of Research and Industry to perform a Ph.D. (MNERT). (Fellowship of \$50000 over 3 years).

2008 Fondation pour la Recherche Medical Award (FRM) for postdoctoral training (\$30000 for one year)

2011 Division of Sleep Medicine Harvard, Poster Session: Poster Award

2011 Society for Neuroscience Hot Topics for poster "Increased pain sensitivity after chronic sleep restriction in mice"

### Invited Talks

#### National

2008 *Differential implication of pro-inflammatory cytokine interleukin-6 (IL-6) in the development of cephalic versus extra-cephalic neuropathic pain.*  
Dartmouth Medical School, Department of Pharmacology and Toxicology, NH.

2011 *Molecular Orchestration of Pain.*  
Music, Science & Medicine at the New York Academy of Sciences, NYC, NY.

2015 *Sepiapterin Reductase as a novel target to treat neuropathic pain.*  
The Burke Medical Research Institute, NY.

2016 *Sleep Disturbances Caused By Peripheral Nerve Injury.* 8<sup>th</sup> World Congress of the World Institute of Pain (WIP), NYC, NY.

2016 *Rare vs. common gene variants as guides to pain mechanisms and drug development.* INITIATIVE ON METHODS, MEASUREMENT, AND PAIN ASSESSMENT IN CLINICAL TRIALS (IMMPACT-XIX), ACCELERATING THE DEVELOPMENT OF PRECISION PAIN MEDICINE. Washington DC.

2017 *Modulating pain through sleep*  
Reeve Irvine Research Center symposium, San Francisco, CA

2018      *Sleep disturbances caused by peripheral nerve injury*  
Blaustein Pain Seminar, Baltimore, MD

**International**

2014      *Reverse engineering pain patients to mice.*  
Official World Congress of Pain Satellite Meeting, Buenos Aires, Argentina.

2018      *Optogenetic Assessment of Peripheral Nerve Regeneration*  
International Spinal Research Trust