

BIOGRAPHICAL SKETCH

NAME: **Gabsang Lee, Ph.D., D.V.M.**

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

POSITION TITLE: **Associate Professor (at Johns Hopkins University School of Medicine)**

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date	FIELD OF STUDY
Seoul National University, Seoul, Korea	B.S.&D.V.M.	02/2000	Veterinary Medicine
Seoul National University, Seoul, Korea	Ph.D.	02/2004	Veterinary Medicine
Sloan Kettering Institute, New York, NY	Postdoc	08/2011	Developmental Biology/ Stem cell biology

A. Personal statement

During my postdoctoral training, I have worked on the derivation of various cell types from human induced pluripotent stem cells (hiPSCs) for disease modeling and drug discovery (Lee *et al.*, *Nature Biotech.*, 2007; Lee *et al.*, *Nature*, 2009; Lee *et al.*, *Nature Protocols*, 2010; Lee *et al.*, *Nature Biotech.*, 2012). As an independent investigator at the Johns Hopkins University School of Medicine (since 2011), my group has continuously worked using stem cell technologies to shape new paradigms, including direct neural fate acquisition process from fibroblasts to induced neural crest with minimal genetic factors (1. Kim *et al.*, *Cell Stem Cell*, 2014), direct derivation of human autonomic neurons to model sympatho-cardiac connection accelerates the *in vitro* cellular maturation (2. Oh *et al.*, *Cell Stem Cell*, 2016), modeling Zika virus infection in peripheral nervous system (3. Oh *et al.*, *Nature Neuroscience*, 2017), and utilizing congruent model system to study a genetic neural disorder (4. Mukherjee-Clavin *et al.*, *Nature Biomedical Engineering*, Accepted). Recently my group developed a new protocol to generate functional myoblasts from hiPSCs, followed by uncovering the *in vitro* phenotypes of the hiPSC lines from multiple Duchenne muscular dystrophy (DMD) patients (5. Choi *et al.*, *Cell Reports*, 2016). Most recently, we created a novel stem cell technology to control protein association upon light illumination via incorporating plant-derived photo-activatable proteins in human pluripotent stem cells. As demonstrated by the collective work, my laboratory has been relentlessly working on modeling human genetic disorders using human pluripotent stem cells.

1. Kim YJ, Lim HT, Li Z, Oh Y, Kovlyagina I, Choi IY, Dong XZ, **Lee G.** Generation of multipotent induced neural crest by direct reprogramming of human postnatal fibroblasts with a single transcription factor. **Cell Stem Cell** 2014 15:497-506. PMID: 25158936
2. Oh YH, Cho GS, Li Z, Hong I, Zhu R, Kim MJ, Kim YJ, Tampakakis E, Tung L, Hukanir R, Dong X, Kwon C, **Lee G.** Functional coupling with cardiac muscle promotes maturation of hPSC-derived sympathetic neurons. **Cell Stem Cell** 2016 PMID: 27320040
3. Oh Y, Zhang F, Wang Y, Lee EM, Choi IY, Lim H, Mirakhori F, Li R, Huang L, Xu T, Wu H, Li C, Qin C-F, Wen Z, Wu Q-F, Tang H, Xu Z, Jin P, Song H, Ming G-L, **Lee G.** Zika virus directly infects human peripheral neurons and induces cell death. **Nature Neuroscience**. 2017 20:1209-1212. PMID: 28758997
4. Mukherjee-Clavin B, Mi R, Kern B, Choi IY, Lim HT, Oh YH, Lannon B, Kim KJ, Bell S, Hur JK, Hwang WC, Habib O, Baloh RH, Eggan K, Brandacher G, Hoke A, Studer L, Kim YJ, **Lee G.** Comparison of three congruent patient-specific cell models for the modelling of a human genetic neurological disorder. **Nature Biomedical Engineering** Accepted
5. Choi IY, Lim HT, Estrellas K, Mula J, Cohen TV, Zhang Y, Donnelly CJ, Richard JP, Kim YJ, Kim HS, Kazuki Y, Oshimura M, Li HL, Hotta A, Rothstein J, Maragakis N, Wager K, **Lee G.** Concordant but varied phenotypes among patient-specific myoblasts of Duchenne muscular dystrophy revealed by a human iPSC-based model. **Cell Reports** 2016 15:2301-12. PMID: 27239027

B. Positions and Honors

Position and Employment

2004-2007 Postdoctoral Researcher at Sloan Kettering Institute (New York, USA)
2007-2007 Nov. BK21 Research Professor at Seoul National University (Seoul, Korea)

2007 Dec.-2008	Research Professor at Korean University Medical Center (Seoul, Korea)
2008-2011	Postdoctoral Research Associate at Sloan Kettering Institute (New York, USA)
2011-2016	Assistant Professor, Institute of Cell Engineering, Department of Neurology and Neuroscience, the Johns Hopkins Translational Tissue Engineering Center.
2016-current	Associate Professor, Institute of Cell Engineering, Department of Neurology, at Johns Hopkins University School of Medicine (Baltimore, USA)

Honors and Award

Excellent Thesis Presentation from Seoul National University, Korea (2004), Travel Award from International Society of Stem Cell Research (2007), New York Stem Cell Foundation Druckenmiller Fellowship (2009) Travel Scholarship from International Consortium of Stem Cell Networks, Canada (2011), New York Stem Cell Foundation Robertson Investigator (2011), ISSCR Abstract Review Committee (2012–), Maryland Stem Cell Research Award (2012, 2013, 2017, 2018), Blaustein Pain Research Award (2013), Program Committee member, Maryland Stem Cell Conference (2014), FSH Society Max Weintraub Memorial Research Fellowship (2015), Mirowski Award for Cardiovascular Research (2015), Organizer for Institute for Cell Engineering Regenerative Medicine Research Seminar Series (2015–). Johns Hopkins Catalyst Award (2016), STAR (Strategy to Accelerate Research) member in the CMT Association (2016-2018), the Johns Hopkins ISCRO Committee (2016–), SAB member in the CMT Research Foundation (2018–)

Scientific Review Activity

• *Grant/applications Review*

NIH Study Section (USA), Telethon Foundation (Italy), Medical Research Council (UK), Biotechnology Research Grant in North Carolina (USA), Helis Marvin Foundation (USA), CMT Association (USA), ICTR ATIP grant program (USA), Muscular Dystrophy Association (USA and UK), ANR (France), Research Grant Council (Hong Kong, China), Samsung Research Foundation (South Korea), Kavli Foundation (USA), JHU PURA program (USA), JHU FARMS Foundation (USA), Israel Science Foundation (Israel), the Hopkins Heart Initiative (USA),

• *Editorial Board*

2018– Experimental Neurology

• *Journal Review*

Biological Psychiatry, Biomaterials, BMC Pediatrics, Brain Research, Cell Reports, Cell Reprogramming, Cells, Cell Stem Cell, Cellular and Molecular Life Science, Expert Opinion on Biological Therapy, FASEB Journal, Frontiers Neuroscience, Future Medicine, Gene Therapy, International Journal of High Throughput Screening, International Journal of Molecular Sciences, Journal of Biomolecular Screening, Journal of Biological Chemistry, Journal of Cell Science, Journal of Cellular Physiology, Journal of Clinical Investigation, Journal of Molecular Science, Journal of Visualized Experiments, Nature Communications, Neurological Research, Nuclei Acid Research, Oncology Reports, PLOS One, Proteomics, Science Advances, Scientific Reports, Stem Cells, Stem Cell and Development, Stem Cell International, Stem Cell Reports, Stem Cell Research, Stem Cells Translational Medicine, Translational Research

Educational Activity

- Mentoring/Trainees: 13 postdoctoral fellows, 1 graduate student, 4 research technicians, 12 visiting/undergraduate research assistants.
- Classroom Teaching: NeuroCog I Course in Neuroscience Graduate Course (2010–present), Advanced Topic in Human Genetics Course (2013–present), and Translational Science Topics in Interdisciplinary Medicine (TIME) course (2016–present)
- Admission Committees for Neuroscience and Biomedical Engineering (BME) Graduate Students, Johns Hopkins School of Medicine

Lab Honors (selected)

2016 Assistant Prof. (tenure-track) appointment, KyungHee University School of Medicine (YongJun Kim)
 2017 Senior Researcher appointment, Samsung Medical Center (Minjeong Kim)
 2017 MSCRF Postdoctoral Fellowship (Congshan Sunny Sun)
 2017 Assistant Prof. (tenure-track) appointment, Chungbuk National University (Yubyeol Jeon)
 2017 MSCRF Postdoctoral Fellowship (Minseong Kim)

2017 MSCRF Postdoctoral Fellowship (Suchan Lee)

2018 Assistant Prof. (tenure-track) appointment, Hanyang University, School of Medicine (Yohan Oh)

Invited Talks (listed since 2017)

The 3rd annual event centered around stem cells, Baltimore (Baltimore, 2018), CMT Association, STAR Face-to-Face meeting (Washington, DC, 2018), The Samsung Stem Cell & Regenerative Medicine Institute (Seoul, Korea, 2018), Ludwig Boltzmann Institute for Experimental and Clinical Traumatology in the AUVA Research Center, Austrian Cluster for Tissue Regeneration (Vienna, Austria, 2018), Asian University Symposium on Biomedical Engineering (Seoul, Korea, 2018), Annual Packard Center for ALS Research (Baltimore, 2018), CBNU-JHU GRDC Meeting/ Annual Conference of Korean Society of Veterinary Medicine (Seoul, Korea, 2018), The Gwangju Institute of Science and Technology (Gwangju, Korea, 2018), Annual Symposium of the Samsung Stem Cell & Regenerative Medicine Institute (Seoul, Korea, 2018), Stem Cell Symposium (Vienna, Austria, 2018), Research Seminar in Vertex (Boston, MA, 2018), Johns Hopkins Biomedical Research Seminar (Baltimore, MD 2017), Global Research Development Center Symposium (Dallas, TX, 2017), Korea Medical Center, Department of Anatomy Seminar Series, (Seoul, Korea, 2017), NSF workshop on "Cellular Biomanufacturing", George Mason University (VA, 2017), New York Stem Cell Foundation, Annual Retreat (New York, NY, 2017), Dept. Molecular Microbiology and Immunology, Keck School of Medicine of USC University of Southern California (LA, CA, 2017), Annual Packard Center for ALS Research (Baltimore, MD, 2017)

C. Contributions to Science

- 1) My recent study has been focusing on how we can study genetic diseases with human induced pluripotent stem cells (hiPSCs), in particular neural crest-related disorders. Based on our original protocol for cell specification toward neural crest, peripheral neurons and Schwann cells (cited in >370 papers), I have modeled multiple diseases with patient-specific hiPSCs (cited in >800 papers), followed by large-scale of drug screening with patient-hiPSC-derived cells, and found several promising compounds (cited in >200 papers). Further, my lab just published a novel approach to convert human fibroblasts into induced neural crest (iNC)(cited in >50 papers), which verified our findings of patient-specific hiPSC studies. My efforts set a new paradigm how to utilize new reprogramming technologies for confronting human genetic disorders in peripheral nervous system and skeletal muscle.
 - a. **Lee G**, Kim HS, Elkabetz Y, Al Shamy G, Panagiotakos G, Barberi T, Tabar V, Studer L. Isolation and directed differentiation of neural crest stem cells derived from human embryonic stem cells. **Nature Biotechnology** 2007 25:1468-1475. PMID 18037878
 - b. **Lee G**, Papapetrou EP, Kim HS, Chambers SM, Tomishima MJ, Fasano CA, Viale A, Tabar V, Sadlani M, Studer L. Modeling Pathogenesis and Treatment of Familial Dysautonomia using patient-specific iPSCs. **Nature** 2009 461: 402-406. PMID 19693009
 - c. **Lee G***, Ramirez CN, KimH, Zeltner N, Liu B, Radu C, Bhinder B, Kim YJ, Choi IY, Mukherjee-Clavin B, Djaballh H, Studer L*. Large-scale screening using familial dysautonomia induced pluripotent stem cells identifies compounds that rescue IKBKAP expression. **Nature Biotechnology** 2012 30:1244-1280. PMID 23159879 * **Corresponding Author**
 - d. Kim YJ, Lim HT, Li Z, Oh Y, Kovlyagina I, Choi IY, Dong XZ, **Lee G**. Generation of multipotent induced neural crest by direct reprogramming of human postnatal fibroblasts with a single transcription factor. **Cell Stem Cell** 2014 15:497-506. PMID: 25158936
- 2) There are many detrimental diseases in the peripheral nervous system, but there is very limited therapeutic intervention, which is mostly due to the lack of humanized model system. We have focused on developing humanized model systems.
 - a. Oh YH, Cho GS, Li Z, Hong I, Zhu R, Kim MJ, Kim YJ, Tampakakis E, Tung L, Hukanir R, Dong X, Kwon C, **Lee G**. Functional coupling with cardiac muscle promotes maturation of hPSC-derived sympathetic neurons. **Cell Stem Cell** 2016 PMID: 27320040
 - b. Oh Y, Zhang F, Wang Y, Lee EM, Choi IY, Lim H, Mirakhori F, Li R, Huang L, Xu T, Wu H, Li C, Qin C-F, Wen Z, Wu Q-F, Tang H, Xu Z, Jin P, Song H, Ming G-L, **Lee G**. Zika virus directly infects human peripheral neurons and induces cell death. **Nature Neuroscience**. 2017 20:1209-1212. PMID: 28758997
 - c. Kurapati S, Sadaoka T, Rajbhandari L, Jagdish B, Shukla P, Ali MA, Kim YJ, **Lee G**, Cohen JI, Venkatesan A. Capturing Role of the JNK Pathway in Varicella-Zoster Virus Lytic Infection and Reactivation. **J Virol**.

2017 91, *PMID*: 28637759

- b. Zeltner N, Fattahi F, Dubois NC, Saurat N, Lafaille F, Shang L, Zimmer B, Tchieu J, Soliman MA, **Lee G**, Casanova JL, Studer L. Capturing the biology of disease severity in a PSC-based model of familial dysautonomia. **Nature Medicine**. 2016 22:1421-7. *PMID* 27841875
- 3) Recently we have another research focus on studying muscular dystrophies with hiPSCs. Our group has developed a novel myogenic specification for Duchenne muscular dystrophy, and identified disease-related phenotypes, which was pharmacologically rescued. We are continuing this line of study to understand human myogenesis and their relevant diseases.
- a. Choi IY, Lim HT, Estrellas K, Mula J, Cohen TV, Zhang Y, Donnelly CJ, Richard JP, Kim YJ, Kim HS, Kazuki Y, Oshimura M, Li HL, Hotta A, Rothstein J, Maragakis N, Wager K, **Lee G**. Concordant but varied phenotypes among patient-specific myoblasts of Duchenne muscular dystrophy revealed by a human iPSC-based model. **Cell Reports** 2016 15:2301-12. *PMID*: 27239027
- 4) Some of my contributions are through collaborations with my colleagues, mostly on hiPSC studies, including cell specification, modeling genetic and infection diseases, and high throughput screening approaches, to address multiple biological questions.
- a. Chambers SM, Qi Y, Mica Y, **Lee G**, Zhang XJ, Niu L, Bilsland J, Cao L, Stevens E, Whiting P, Shi SH, Studer L. Combined small-molecule inhibition accelerates developmental timing and converts human pluripotent stem cells into nociceptors. **Nature Biotechnology** 2012 30:715-720. *PMID* 22750882
- b. Choi J, Lee S, Clement K, Mallard W, Tagliazucchi GM, Lim H, Choi IY, Ferrari F, Tsankov A, Pop R, **Lee G**, Rinn J, Meissner A, Park PJ, and Hochedlinger K. A comparison of genetically matched cell lines reveals the equivalence of human iPSCs and ESCs. **Nature Biotechnology** 2015 33:1173-81. *PMID* 26501951.
- c. A Dynamic Unfolded Protein Response Contributes to the Control of Cortical Neurogenesis. Laguesse S, Creppe C, Nedialkova DD, Prévot PP, Borgs L, Huysseune S, Franco B, Duysens G, Krusy N, **Lee G**, Thelen N, Thiry M, Close P, Chariot A, Malgrange B, Leidel SA, Godin JD, Nguyen L. **Developmental Cell**. 2015 35:553-67. *PMID* 26651292.
- d. PLEKHG3 enhances polarized cell migration by activating actin filaments at the cell front. Nguyen TT, Park WS, Park BO, Kim CY, Oh Y, Kim JM, Choi H, Kyung T, Kim CH, **Lee G**, Hahn KM, Meyer T, Heo WD. **PNAS**. 2016 113:10091-6. *PMID* 27555588
- 5) To share our newly developed protocols and opinions, I have published protocols and reviews papers.
- a. Choi IY, Lim HT, **Lee G***. Efficient generation human induced pluripotent stem cells from human somatic cells with sendai-virus. 2014 86:51406. *PMID*: 24798302 **JoVE**. * **Corresponding Author**
- b. Lim HT, Choi IY, **Lee G***. Profiling individual human embryonic stem cells by quantitative RT-PCR. 2014 87:51408. *PMID*: 24961819 **JoVE** * **Corresponding Author**
- c. **Lee G**, Chambers SM, Tomishima MJ, Studer L. Derivation of neural crest cells from human pluripotent stem cells. **Nat Protoc**. 2010;5:688-701.
- d. Kim YJ, **Lee G***. Candidate ALS Therapeutics Motor toward "In Vitro Clinical Trials". **Cell Stem Cell**. 2013 12:633-644. *PMID* 23746968 * **Corresponding Author**

Complete List of Published Work in MyBibliography:

<https://www.ncbi.nlm.nih.gov/myncbi/gabsang.lee.1/bibliography/public/>