阿茲海默症暨相關疾病生物標記國際研討會

隨著全世界失智症患者人數不斷的快速增長，其中罹患比例最高 (超過 60 %) 的阿茲海默症對全球社會的影響也日益加大，因此針對阿茲海默症的早期或臨床前診斷的研究就成為如何成功治療的重要關鍵。在不同的生物標記上，包括醫學成像，基因和生化檢測等檢驗方法，皆早已針對阿茲海默症的早期診斷或療效追蹤進行開發，近期更發展出創新的尖端技術，達成可能使用血液中的生物標記濃度來檢測出阿茲海默症的可靠方法。在世界各地，如美國，歐洲及亞洲的研究專家學者們，持續的在探索血液中可能的生物標記，及生物標記與其它檢測方法，如神經心理學，醫學成像和神經病理學之間的關係。即將於 2016 年 10 月 26 日在台北舉行的阿茲海默症暨相關疾病生物標記國際研討會，邀請了國內外的知名專家，就他們本身團隊多年的研究成果提出寶貴的看法和發現，希望讓大家能夠了解到更多有關血液中的生物標記在阿茲海默症及相關疾病的臨床診斷上的潛在可能。

演講主題

神經影像學在失智症的預防及診斷上的現況及未來發展

腦脊髓液及血液中的生物化學標記的現況及未來發展

生物標記在預防治療及臨床治療上的現況及未來發展

組織委員會

主席兼召集人:

邱銘章醫師, 臺大醫學院教授, 神經部主治醫師

委員:

白明奇醫師, 成大醫學院教授, 台灣臨床失智症學會理事長

曾文毅醫師, 臺大醫院分子生醫影像研究中心主任

Lih-Fen Lue, Research Prof., Neurodegenerative Disease Research Center, Arizona State University, USA

陳達夫醫師, 臺大醫院神經部主治醫師

楊謝樂博士, 磁量生技 CEO

演講貴賓

Kaj Blennow, M.D., PhD., Prof. of Clinical Neurochemistry, University of Gothenburg, Sweden
- Fluid biomarkers for Alzheimer's disease – moving from CSF to blood biomarkers

Kewei Chen, PhD., Director, Computational Image Analysis Program Biomathematician, Neuroimaging, Banner Alzheimer's Institute, USA
- TBD

邱銘章醫師, 臺大醫學院教授, 神經部主治醫師

- Plasma biomarkers for discriminating various types of dementia

李妮鍾醫師, 臺大醫院基因學部暨小兒部主治醫師

- Amyloid and tau protein as biomarkers for the detection of early degeneration in Down syndrome – comparative study with Alzheimer disease in general population

Lih-Fen Lee, PhD., Research Prof., Neurodegenerative Disease Research Center, Biodesign Institute, Arizona State University, USA
- Plasma Aβ_{42} and total tau levels combined attain high discriminatory sensitivity for Alzheimer's dementia: investigations in Sun City of Arizona and Taiwanese cohorts

Marwan Sabbagh, M.D., Director, Barrow Neurological Institute, USA
- Incorporation of novel biomarkers into clinical practice to improve the diagnostic confidence for Alzheimer's dementia

戴恆青博士, 台灣大學化學系副教授

- Synaptic pathology in Alzheimer's disease and its link to biomarker discovery

贊助者(主辦)

臺大醫院腦神經內科

磁量生技股份有限公司

贊助者(協辦)

台灣臨床失智症學會

臺大醫院分子生醫影像研究中心

研討會時程

時間	主題
9:00~9:30	開幕
9:30~10:15	演講
10:15~10:30	休息
10:30~11:15	演講
11:15~12:00	演講
12:00~13:15	中餐
13:15~14:00	演講
14:00~14:45	演講
14:45~15:00	休息
15:00~15:45	演講
15:45~16:30	演講
16:30~17:30	綜合座談&結語

聯絡人

劉秉勳 博士, 磁量生技

Email: fresh.liu@magqu.com

Phone: +886-2-86671897

Kaj Blennow, M.D., PhD.

Professor and Academic Chair

Clinical Neurochemistry

University of Gothenburg

Sweden

Affiliation & Address:

E-mail Address: Kaj.Blennow@neuro.gu.se

Professional preparation:

Medical degree (MD), Lund University, 1984

Registered doctor (Legitimerad läkare), 1986

Specialist competence in general psychiatry, 1993

Specialist competence in clinical chemistry, 1994

Doctor in Medical Science (PhD), Gothenburg, thesis in General Psychiatry, 1990.

Appointments:

The Torsten Söderberg Professorship in Medicine and the Royal Swedish Academy of Sciences, 2015-

Appointed the title "University Hospital Senior Physician", 2011-

Professor and Academic Chair in Clinical Neurochemistry, University of Gothenburg, 2003-

Senior Consultant and Head of the Clin. Neurochemistry Lab., Sahlgrenska University Hospital (1995-)

Post as Researcher at the Medical Research Council (MRC), Sweden, 1997-2002

Ass. Professor (Docent), University of Göteborg, 1994.

International projects:

- *President of the "the Society for CSF analysis and Clinical Neurochemistry", which started in 2015, and is an International Society to promote research and the us of CSF biomarkers in the clinic and in trials.*
- *Head of the project "The Alzheimer's Association QC program for CSF biomarkers", which started in 2009, and involves more than 90 CSF laboratories world-wide.*
- *Head of the International Federation of Clinical Chemistry (IFCC) working group on CSF proteins, with the aim to develop a reference method and reference material for CSF biomarkers (2012-).*
- *EC project "LipidiDiet", led by Prof. T. Hartman, Germany. The project involves 12 research teams in Europe, our lab is the neurochemistry/biomarker core.*

- *Member of the US AD Neuroimaging Initiative (ADNI) Resource Allocation Review Committee (2005-).*
- *Advisor in the NIA project "Alzheimer's disease prevention initiative" (API)*
- *Member of the Eur. Healthcare Innov. Leadership Network Alzheimer Dis. Working Group.*

Congresses:

- *Invited speaker for plenary lecture on 13 International Congresses, such as the AAIC, IPA, ECNP and ACNP congresses.*
- *Invited speaker and participant in 14 specialized meetings, such as the NIH Working Group on AD Biochemical Markers (1999), the Nature Medicine Translational Neuroscience Symposium (2009), the Nature Medicine Symposium on Neurodegeneration (2010), the Nature Medicine Global Alzheimer's Research Summit (2011), and the Keystone Symposia (2012).*

Research prizes:

- *The European College of Neuropsychopharmacology (ECNP) Award, Monte Carlo, 1991.*
- *The Collegium Internationale Neuro-Psychopharmacologicum (CINP) Award, Nice, 1992.*
- *The Ole J Rafaelsen Award in Biol. Psychiatry and Neuropsychopharmacology, Copenhagen, 1993.*
- *The International Psychogeriatric Association (IPA) Research Award, Berlin, 1993.*
- *Lundbeckfonden/Scandinavian Society of Psychopharmacology Scholarship, Copenhagen, 1994.*
- *Nordic Society for Research in Brain Aging (NORAGE) Research Award, Oslo, 1994.*
- *The Inga Sandeborgs Price, Swedish Medical Association, for Research in AD, Stockholm, 1996.*
- *The Alois Alzheimer Research Award, Munich, Germany, 2001.*
- *The European College of Neuropsychopharmacology (ECNP) Research Award, Amsterdam, 2010.*
- *The Henry Wisniewski Lifetime Achievement Award in AD Research, by the Alzheimer's Association, at the International Conference on Alzheimer's disease (AAICAD) 2011 in Paris, France.*
- *The David Ingvar Price, Swedish Med. Association, for research in Neuroscience, Stockholm, 2011.*
- *The Silviahemmet Price in Alzheimer research, presented by HM Queen Silvia, Stockholm, 2012.*
- *The Eric Forsgren Price in Alzheimer research, presented by Umeå University, Umeå, 2012.*
- *The Int. Foundation for Research in Alz. dis (IFRAD) European Grand Prix in Research, Paris, 2013.*
- *The Torsten Söderberg Professorship in Medicine and the Royal Swedish Academy of Sciences, 2015.*
- *The Söderberg Price in Medicine at the Swedish Medical Society, 2016.*

Publications:

- *About 750 original research papers and 120 reviews in peer-reviewed journals.*
- *Citation report on Scopus (June 2016)* ***h-index: 98***

  Number of Papers: 861

  Number of Citations: 41.662 (during 2015: 5.210)

Fluid biomarkers for Alzheimer's disease – moving from CSF to blood biomarkers

Kaj Blennow, MD, PhD

Inst. of Neuroscience and Physiology, Dept. of Psychiatry and Neurochemistry, The Sahlgrenska Academy at University of Gothenburg, Mölndal, Sweden

Fluid biomarkers for Alzheimer's disease (AD) and other neurodegenerative disorders are highly important for use as diagnostic tools in clinical routine and for enrichment purposes in clinical trials. In addition, fluid biomarkers show promise as theragnostic markers in clinical trials, to identify and monitor target engagement of the drug, and to identify downstream effects on neurodegeneration.

A panel of AD cerebrospinal fluid (CSF) biomarkers has been developed, including total tau (T-tau) reflecting the intensity of neuronal degeneration, phospho-tau (P-tau) correlating with brain tau pathology load, and β-amyloid (Aβ42 or Aβ42/40 ratio) reflecting cortical Aβ deposition. A high diagnostic performance of these core AD biomarkers have been well validated in numerous clinical studies, also to identify AD in the prodromal stage of the disease. Further, neurofilament light (NFL) protein shows promise as a biomarker for axonal degeneration, and the synaptic protein neurogranin as a measure of synaptic integrity.

Recent technological developments have given ultrasensitive analytical techniques (immunomagnetic reduction technology and single molecule array) that allows for quantification of brain specific proteins in blood (serum or plasma) samples. Plasma levels of Aβ42 and the Aβ42/Aβ40 ratio were found to correlate with CSF levels and also with high amyloid ligand retention on amyloid PET scans. High tau levels in plasma was found in AD dementia, with longitudinal analyses showing associations between high baseline plasma tau and future rate of cognitive deterioration, progression of hippocampal atrophy on MRI, and reductions in hypometabolism on FDG-PET. High plasma levels of NFL were found in several neurodegenerative disorders, including AD, and show promise as a screening tool to identify neurodegeneration. In conclusion, new ultrasensitive assays may serve as the basis for clinically useful blood biomarkers for AD and other neurodegenerative disorders.

Marwan Sabbagh, M.D.

Director, Alzheimer's and Memory Disorders Division

Professor of Neurology

United States

Affiliation & Address:

Barrow Neurological Institute

240 W. Thomas Rd, Ste 301

Phoenix AZ 85013

Phone: 602.406.4784

Fax: 602.798.9963

E-mail Address: Marwan.sabbagh@dignityhealth.org

Academic background:

1987, B.A. - University of California - Berkeley

1991, M.D. - University of Arizona College of Medicine

Professional career:

2008-2011: Chief Medical-Scientific Officer and Research Medical Director, Banner-Sun Health Research Institute

2010-2015: Senior Scientist, Haldeman Lab

2000-2015: Director, The Cleo Roberts Center for Clinical Research, Banner-Sun Health Research Institute

2015-present: Director, Alzheimer's and Memory Disorders Division, Barrow Neurological Institute

Expertise:

Diagnosis, treatment and research of Alzheimer's disease, and other memory disorder conditions including dementia. Leading investigator for many prominent national Alzheimer's prevention and treatment trials, including Alzheimer immunotherapy studies.

Professional services and honors:

- *Student Summer Fellow, Arizona Cancer Society, 1988*
- *Student Representative to the Western Federation of Clinical Research, University of Arizona, 1990*

- *Allistair Karmody Award Finalist, 1991*
- *Travel Fellowship Award Recipient, American Neurological Association, 1996*
- *Peter F Drucker Award Co-recipient, 1998*
- *Dystonia Doctor of Excellence, San Diego County, 2000*
- *Life Member of the National Registry of Who's Who #172142, 2001*
- *Arizona Business Journal, Healthcare Hero Finalist 2004*
- *Fellow of the American Academy of Neurology 2004*
- *WestMarc Innovator Award, 2015*

Recent main publications (Dr. Sabbagh has published more than 200 SCI papers):

1. *Gender Differences in Alzheimer Disease: Brain Atrophy, Histopathology Burden, and Cognition.*

   *Filon JR, Intorcia AJ, Sue LI, Vazquez Arreola E, Wilson J, Davis KJ, **Sabbagh MN**, Belden CM, Caselli RJ, Adler CH, Woodruff BK, Rapscak SZ, Ahern GL, Burke AD, Jacobson S, Shill HA, Driver-Dunckley E, Chen K, Reiman EM, Beach TG, Serrano GE. J Neuropathol Exp Neurol. 2016 Jun 12. pii: nlw047. [Epub ahead of print]*

2. *Sex and post-menopause hormone therapy effects on hippocampal volume and verbal memory.*

   *Braden BB, Dassel KB, Bimonte-Nelson HA, O'Rourke HP, Connor DJ, Moorhous S, **Sabbagh MN**, Caselli RJ, Baxter LC. Neuropsychol Dev Cogn B Aging Neuropsychol Cogn. 2016 Jun 4:1-20. [Epub ahead of print] PMID: 27263667*

3. *Impact of Training Method on the Robustness of the Visual Assessment of 18F-Florbetaben PET Scans: Results from a Phase-3 Study.*

   *Seibyl J, Catafau AM, Barthel H, Ishii K, Rowe CC, Leverenz JB, Ghetti B, Ironside JW, Takao M, Akatsu H, Murayama S, Bullich S, Mueller A, Koglin N, Schulz-Schaeffer WJ, Hoffmann A, **Sabbagh MN**, Stephens AW, Sabri O.J Nucl Med. 2016 Jun;57(6):900-6. doi: 10.2967/jnumed.115.161927. Epub 2016 Jan 28.PMID: 26823561*

4. *Graph theory network function in Parkinson's disease assessed with electroencephalography.*

   *Utianski RL, Caviness JN, van Straaten EC, Beach TG, Dugger BN, Shill HA, Driver-Dunckley ED, **Sabbagh MN**, Mehta S, Adler CH, Hentz JG.*

   Clin Neurophysiol. 2016 May;127(5):2228-36. doi: 10.1016/j.clinph.2016.02.017. Epub 2016 Mar 4.PMID: 27072094

5. *Cortical phosphorylated α-Synuclein levels correlate with brain wave spectra in Parkinson's disease.*

Caviness JN, Lue LF, Hentz JG, Schmitz CT, Adler CH, Shill HA, ***Sabbagh MN****, Beach TG, Walker DG.*

Mov Disord. 2016 Apr 8. doi: 10.1002/mds.26621. [Epub ahead of print]

PMID: 27062301

Incorporation of novel biomarkers into clinical practice to improve the diagnostic confidence for Alzheimer's dementia

Marwan N. Sabbagh MD[1], LihFen Lue PhD[2]

[1] Department of neurology, Barrow Neurological Institute, Phoenix AZ

[2] Center for Neurodegenerative Research, Arizona State University, Tempe AZ

Background: Establishing the in-vivo diagnosis of Alzheimer's disease (AD) or other dementias relies on clinical criteria, although their accuracy can be limited. The diagnostic accuracy is 77% for a clinical diagnosis of AD, even amongst the experts.

Methods: We performed a comprehensive analysis of the specific modalities including Apo E, CSF, FDG PET, Amyloid PET, Tau-PET, SPECT, CT, MRI, screening labs (B12 and TSH) to determine the specificity and sensitivity of each test in the clinical diagnosis of AD. This was done through a review of PubMed. We added the Novel immunomagnetic reduction platform (MagQu Assay that provides ultra-sensitivity for measuring plasma Tau and amyloid beta 42) to assess to this analysis.

Results: The sensitivity of a diagnosis of AD is best rendered with invasive and expensive CSF testing. The sensitivity and specificity of the current diagnostic approach (structural CT or MRI with screening labs) remains low for clinical detection of AD and is still used to exclude other conditions mainly. The sensitivity and specificity of different PET modalities will be presented. Estimates of sensitivity and specificity of the ultrasensitive immunomagnetic reduction platform will be presented.

Conclusion: With limited diagnostic capabilities, physicians do not feel comfortable or skilled in rendering a clinical diagnosis of AD. Compounding this is the fact that inexpensive, minimally invasive diagnostics do not yet exist. There is a need for developing blood borne biomarkers that can aid in the clinical diagnosis of AD. One consideration is a tiered approach to a diagnosis.

Lih-Fen Lue, PhD.

Research Professor

Neurodegenerative Disease Research Center (NDRC)

Biodesign Institute

Arizona State Unviersity

United States

Affiliation & Address:

NDRC and Life Sciences Department

Biodesign Institute

Arizona State University

427 East Tyler Mall, LSE Room 535

Tempe, Arizona 85287-4501

United States

Phone: +1-480-727-3852 (Office); +1-480-727-3851 (Laboratory)

E-mail Address: lih-fen.lue@asu.edu

Education:

1973, B.S. Animal Husbandry, National Taiwan University, Taipei, Taiwan

1975, M.S. in Animal Husbandry, National Taiwan University, Taipei, Taiwan

1983, PhD. in Animal Science, Iowa State University, Ames, Iowa, USA

1985-1987, Postdoctoral Fellow, Department of Anatomy, Veterinary Medical College, Iowa State University, Ames, Iowa, USA

Professional career:

1975-1978: Research Scientist, Pig Research Institute, Tzu Nan, Mioli, Taiwan

1991-1995: Staff Scientist, Sun Health Research Institute, Sun City, AZ

1995-2000: Principal Scientist, Sun Health Research Institute, Sun City. AZ

2000-2007: Senior Scientist, Sun Health Research Institute, Sun City, AZ

2007-2015: Senior Scientist, Banner Sun Health Research Institute, Sun City, AZ

2015-present: Research Professor, NDRC, Biodesign Institute, ASU, Tempe, AZ

Expertise:

- *Research in neurodegenerative disease inflammatory mechanisms*
- *Blood biomarker development for neurodegenerative diseases*

- *Development of postmortem human brain cell models*
- *Use of human postmortem brain cells to model microglial activation in neurodegenerative diseases*

Professional services and lectures

Services:

- *Manuscript reviewer of many scientific journals; Grant reviewer of US Federal Funding Agents and International Funding Agents*
- *Scientific Member of Institutional Animal Care and Use Committee, Sun Health Research Institute, 1998-2008 and Banner Sun Health Research Institute, 2008-2014*
- *Student Internship Program Supervisor: Supervisors of high school and college student interns, Sun Health and Banner Sun Health Research Institute, 1996-present; Mentorship Program: Faculty of Undergraduate Biology Research Program of University of Arizona, 2013; Faculty of Undergraduate Student Research Program, Arizona State University, 2015-present*

Lectures:

Special Topic Lecturers in University of Nebraska Medical College, Omaha, Nebraska, USA, October, 2005; RIKEN Alzheimer's Disease Conference, October, 2006, Tokyo, Japan; National Cheng Kung Medical College, Tainan, and Sinica Academia, Taipei, 2008; The 22nd Biennial Meeting of the International Society of Neurochemistry/APSN Joint Conference, Taipei, Taiwan, August, 2009; Neurobiology Department, Yang Ming Medical School, 2010; "New Frontiers of Medical Science", Science Museum of Phoenix, AZ, March, 2014.

Selected recent publications (over 70 peer-reviewed scientific publications)

1. ***Lue LF,*** *et al., TREM2 Protein Expression Changes Correlate with Alzheimer's Disease Neurodegenerative Pathologies in Post-Mortem Temporal Cortices. Brain Pathol. 2014 Sep 3. doi: 10.1111/bpa.12190.*
2. ***Lue LF,*** *et al. What happens to microglial TREM2 in Alzheimer's disease: Immunoregulatory turned into immunopathogenic? Neuroscience. 2015 Aug 27;302:138-50. doi: 10.1016/j.neuroscience.2014.09.050. Epub 2014 Oct 2.*
3. *Walker DG,* ***Lue LF****. Immune phenotypes of microglia in human neurodegenerative disease: challenges to detecting microglial polarization in human brains. Alzheimers Res Ther. 2015 Aug 19;7(1):56.*
4. ***Lue LF,*** *et al., Converging mediators from immune and trophic pathways to identify Parkinson disease dementia. Neurol Neuroimmunol Neuroinflamm. 2016;3(1):e193.*

5. *Caviness JN, **Lue LF**, et al., Cortical phosphorylated α-Synuclein levels correlate with brain wave spectra in Parkinson's disease. Mov Disord. 2016 Apr 8. doi: 10.1002/mds.26621*

Plasma Aβ42 and total tau levels combined attain high discriminatory sensitivity for Alzheimer's dementia: investigations in Sun City of Arizona and Taiwanese Cohorts

Lih-Fen Lue[1], Marwan Sabbagh[2], Kewei Chen[3], Eric Reiman[3], Shieh-Yueh Yang[4], Herng-Er Horng[5], Ming-Jang Chiu[6,7]

[1]Neurodegenerative Disease Research Center, Arizona State University, Tempe, AZ, 85287, USA

[2] Alzheimer's and Memory Disorders Center, Barrow Neurological Institute, Phoenix, AZ, 85013, USA

[3]Banner Alzheimer's Institute, Arizona State University of Arizona, Arizona Alzheimer's Consortium; Phoenix, AZ, 85006, USA

[4]MagQu Co., Ltd., New Taipei City 231, Taiwan

[5]Institute of Electro-optical Science and Technology, National Taiwan Normal University, Taipei 116, Taiwan

[6]Graduate Institute of Brain and Mind Science, College of Medicine, National Taiwan University, Taipei 100, Taiwan

[7]Department of Neurology, National Taiwan University Hospital, College of Medicine, National Taiwan University, Taipei 100, Taiwan

Background: Utility of plasma Aβ42 and total tau (t-tau) levels in the clinical diagnosis of Alzheimer's dementia (AD) relies on the availability of highly sensitive assays that could detect narrow differences in low pg/ml concentration range. To overcome this issue, a novel technology using superconducting quantum interference device to detect immunomagnetic reduction (IMR) signals to assay biochemical levels of AD core proteins Aβ and t-tau have been developed. In last few years, the IMR assays for AD blood biomarker research have been intensively studied in the Taiwanese cohorts. To advance the utility of these assays in AD diagnosis, there is a need to assess how these assays performed in the cohort other than Taiwanese. Thus, we carried out the study to evaluate the ability of plasma Aβ42 and total tau levels for identifying clinical AD in a cohort recruited from Sun City of Arizona. The

objective was to determine how the criteria of distinguishing AD from normal controls were comparable between Sun City and Taiwanese cohorts.

Methods: The study cohort was recruited from the clinic of Banner Sun Health Research Institute (BSHRI) in the Sun City of Arizona and the validation cohort was recruited from National Taiwan University Hospital (NTUH) in Taiwan. 16 non-demented controls (NCs) and 16 ADs were recruited at the BSHRI site, while 63 NCs and 31 ADs were enrolled at the NTUH site. Plasma levels of Aβ42 and t-tau were measured by protein-specific IMR assays. Data from BSHRI cohort were analyzed for the best sensitivity and specificity for discrimination of AD from ND. The cut-off criteria for the levels of Aβ42 and t-tau individually or combined as concentration product were applied to NTUH cohort to determine their ability of predicting AD.

Results: The cut-off values obtained from BSHRI cohort were 23.99, 15.15, and 362.20 pg/ml for t-tau, Aβ42 and the product of Aβ42 and t- tau, respectively. The cut-off value of the product of Aβ42 and tau provided the highest sensitivity (94%) for discriminating ADs from NCs. When we used this cut-off value in the NTUH cohort, sensitivity was100% and specificity was 84%.

Conclusion: These findings support that plasma levels of Aβ42 and t-tau protein measured by IMR technology hold the potentials as blood biomarkers for clinical diagnosis of the AD.

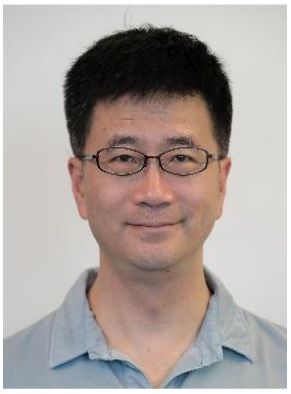
Ming-Jang Chiu, M.D., PhD.

Attending Neurologists & Professor

Director of the Diagnostic Neurophysiology Division

Department of Neurology

National Taiwan University



Affiliation & Address:

Department of Neurology,

National Taiwan University Hospital,

No. 7, Chung-Shan Rd. Taipei, Taiwan

E-mail: mjchiu@ntu.edu.tw

Academic background:

1984, M.B. College of Medicine, National Taiwan University, Taipei, Taiwan

2000, PhD. Graduate Institute of Electric Engineering, National Taiwan University, Taipei, Taiwan

Professional career:

Attending Neurologists & Professor, 2014-

Director of the Diagnostic Neurophysiology Division 2009-

Graduate Institute of Brain and Mind Sciences / Graduate Institute of Psychology / Graduate Institute of Biomedical Electronics and Bioinformatics, National Taiwan University

Expertise:

Board certificated neurologist

Board certificated physician in Sleep Medicine

Professional services and honors:

- *President of Taiwan Alzheimer's Disease Association. 2010-2015*

Recent main publications (Dr. Chiu has published more than 116 SCI papers):

1. ***Chiu MJ****. Systemic infection may cause cognitive decline and neurodegeneration. Critic Care Med 2014; 42:1282-1283. Invited editorial.*
2. *YC Lin, YC Shih, WY I Tseng, YH Chu, MT Wu, TF Chen, PF Tang*, **MJ Chiu**. Cingulum correlates of cognitive functions in patients with mild cognitive impairment and early*


Alzheimer's disease - A diffusion spectrum imaging study. Brain Topography 2014 Jan 11.

3. *Chen TF, Tang MC, Chou CH, **Chiu MJ**, Huang RF. Dose-dependent folic acid and memantine treatments promote synergistic or additive protection against Aβ(25-35) peptide-induced apoptosis in SH-SY5Y cells mediated by mitochondria stress-associated death signals. Food Chem Toxicol. 2013 Dec;62: 538-47. doi: 10.1016/j.fct.2013.09.015. Epub 2013 Sep 17*
4. *LY Fan, **MJ Chiu***. Combotherapy and current concepts as well as future strategies for the treatment of Alzheimer's disease. Neuropsychiatric Disease anf Treatment 2014 ; 10:439-451.*
5. *CH Lin, TF Chen, **MJ Chiu**, RM Wu. Lack of C9orf72 repeat expansion in Taiwanese patients with mixed neurodegenerative disorders. Frontiers in Neurology, 2014 April*
6. *Li HC, Chen YS, **Chiu MJ**, Fu MC, Huang GH, Chen CCH. (2014). Delirium, Subsyndromal Delirium, and Cognitive Changes in Individuals Undergoing Elective Coronary Artery Bypass Graft Surgery. Journal of Cardiovascular Nursing, in press.*
7. *Y Sun, HJ Lee, SC Yang, TF Chen, KN Lin, CChi Lin, PN Wang, L Tang, **MJ Chiu***. A nationwide survey of mild cognitive impairment and dementia, including very mild dementia, in Taiwan, PloS One. Accepted 2014*
8. *KY Tzen, SY Yang, TF Chen, TW Cheng, HE Horng, HP Wen, YY Huang, CY Shiue, **MJ Chiu***, Plasma Aβ but not tau related to brain PiB retention in early Alzheimer's disease. In revision. ACS Neurosci 2014.*
9. *YL Chang, TF Chen, **MJ Chiu**, YC Shih, WYI Tseng, SH Yan, Regional Cingulum Disruption, Not Gray Matter Atrophy, Detects Cognitive Changes in Amnestic Mild Cognitive Impairment Subtypes. J Alzheimers Dis. 2015;44(1):125-38.*
10. *Chang HT, **Chiu MJ**, Chen TF, Cheng TW, Hua MS, Distinct Patterns and Clinical Implications of Semantic Memory Deterioration Among Patients With MCI. Alzheimer Dis Assoc Disord. 2015 Apr-Jun;29(2):124-34.*
11. *Kao HL, Lin MS, Wu WC, Tseng WY, Su MY, Chen YF, **Chiu MJ**, Wang SY, Yang WS, Tzen KY, Wu YW, Chen MF, Improvement of Cerebral Glucose Metabolism in Symptomatic Patients With Carotid Artery Stenosis After Stenting. Clin Nucl Med. 2015 Sep;40(9):701-7.*
12. *Cheng YW, Lee MJ, Chen TF, Cheng TW, Lai YM, Hua MS, **Chiu MJ***. A single nucleotide TDP-43 mutation within a Taiwanese family – a multi-faceted demon. Amyotrophic Lateral Sclerosis and Frontotemporal Degeneration 2015, Sep. Accepted*
13. *Fan LY, Sun Y, Lee HJ, Yang SC, Chen TF, Lin KN, Lin CC, Wang PN, Tang LY, **Chiu MJ***, Marital status, lifestyle and dementia: A nationwide survey in Taiwan. PLoS One 2015, Sep. Accepted*
14. *Cheng YW, Chen TF, Cheng TW, Lai YM, Hua MS, Chen YF, **Chiu MJ***. Hippocampal Atrophy but not White-matter Changes predicts the Long-term Cognitive Response to Cholinesterase Inhibitors in Alzheimer's disease. Alzheimer's Research & Therapy 2015, Oct Accepted*
15. *Shen CP, Lin JW, Lin FS, Lam AYY, Chen W, Zhou WZ, Sung HY, Kao YH, **Chiu MJ**, Leu FY, Lai*


FP. GA-SVM Modeling of Multiclass Seizure Detector in Epilepsy Analysis System Using Cloud Computing. Journal Soft Computing 2015, Oct Accepted.

16. *Tsai DFC, Hsu YR, Hwang TJ, Chen CY, **Chiu MJ**. Ethical Issues in the Treatment and Care for Dementia Patients. Formosan J Med. 2015;19:499-507. (In Chiese)*
17. *Tsaih PL, **Chiu MJ**, Luh JJ, Yang YR, Hu MH. Effects of electromyographic biofeedback muscle training on motor function and cortical excitability in stroke patients. Physiotherapy 5/2015;101:e1538-e1539.*
18. *Yu RL, Tang CH, Wu YR, Wu RM, **Chiu MJ**, Hua MS. Memory for gist and detail information in patients with Parkinson's disease. BMJ Open 11/2015;5(11): e009795.*
19. *Yang SY, **Chiu MJ**, Lin CH, Horng HE, Yang CC, Chieh JJ, Chen HH, Liu BH. Development of an ultra-high sensitive immunoassay with plasma biomarker for differentiating Parkinson disease dementia from Parkinson disease using antibody functionalized magnetic nanoparticles. J Nanobiotechnology. 2016 Jun 8;14(1):41.*

Plasma biomarkers for discriminating various types of dementia

Ming-Jang Chiu,[1,2,3,4] Chin-Hsien Lin,[1] Ta-Fu Chen,[1] Che-Chuan Yang,[5] and Shieh-Yueh Yang[5]

[1]Department of Neurology, National Taiwan University Hospital, College of Medicine, National Taiwan University, Taipei 100, Taiwan

[2]Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, Taipei 100, Taiwan

[3]Department of Psychology, National Taiwan University, Taipei 100, Taiwan

[4]Graduate Institute of Biomedical Engineering and Bioinformatics, National Taiwan University, Taipei 116, Taiwan

[5]MagQu Co., Ltd., Xindian District, New Taipei City 231, Taiwan

Different metabolic dysfunctions cause over expression or depletion of proteins in brain, and result in various types of dementia. These proteins of abnormal levels are conventionally assayed in cerebrospinal fluid (CSF). It is so difficult to assay these proteins in peripheral fluid, such as plasma, because that the concentrations of these proteins are ultra-low in peripheral fluid. Authors developed an ultra-sensitive assay technology, so-called immunomagnetic reduction (IMR), which showed the low-detection limit at the levels of pg/ml or fg/ml, depending on kinds of proteins. Furthermore, authors demonstrated the feasibility of differentiating patients with mild cognitive impairment (MCI) due to Alzheimer's disease (AD) or AD from healthy controls by assaying amyloid β (Aβ) and tau protein in human plasma. In this work, in addition to AD (n= 12), patients with other types of dementia such as Parkinson disease dementia (PDD) (n = 13), dementia with Lewy body (DLB) (n = 14), frontotemporal dementia (FTD) (n = 12) are recruited for exploring the concentrations of A$\beta_{1\text{-}42}$, tau protein, and α-synuclein in plasma by using immunomagnetic reduction. Healthy controls (n = 13) show the concentrations of A$\beta_{1\text{-}42}$ and tau protein in plasma with (15.29$\pm$1.60) and (16.16$\pm$9.09) pg/ml, respectively. While ultra-low and wide-range concentrations from 0.04 fg/ml to 30 fg/ml are found for plasma α-synuclein with healthy controls. Patients with AD or FTD show the highest concentrations in plasma A$\beta_{1\text{-}42}$ or tau protein. The concentrations of plasma A$\beta_{1\text{-}42}$ or tau protein for PDD patients are


slightly higher than that of healthy controls. There is no significant difference in concentrations of plasma A$\beta_{1\text{-}42}$ or tau protein between DLB patients and healthy controls. In order to further differentiate AD from FTD, as well as DLB from healthy controls, the concentrations of plasma α-synuclein were detected. Clear differences in concentrations of plasma α-synuclein are found between AD and FTD, and between DLB and healthy controls. Hence, by using concentrations of A$\beta_{1\text{-}42}$, tau protein, and α-synuclein in plasma, AD (n = 12), FTD (n = 12), PDD (n = 12), DLB (n = 14), and healthy controls (n = 13) can be well discriminated.

Ni-Chung Lee, M.D., PhD.

Clinical associate professor

Department of Pediatrics

National Taiwan University

Affiliation & Address:

Department of Medical Genetics,

National Taiwan University Hospital,

Room 19005, 19F, Children Hospital Building,

8 Chung-Shan South Road,

Taipei 10041, Taiwan

Tel: 886-2-2312 3456 ext 71936

Fax: 886-2-2331 4518

e-mail: ncleentu@ntu.edu.tw

Academic background:

1999 M.D., Medical College, National Yang-Ming University

2014 Ph.D., Graduate Institute of Clinical Medicine, College of Medicine, National Taiwan University

Professional career:

2006- now Attending Physician, Department of Medical Genetics and Pediatrics, NTUH, Taipei, Taiwan

2006-2010 Lecturer, Department of Pediatrics, NTU, Taipei, Taiwan

2010-2011 Research Fellow, Department of Pediatrics and Powell Gene Therapy Center, University of Florida

2010-2013 Adjunct assistant professor, Department of Pediatrics, NTU, Taipei, Taiwan2

013-2016 Clinical assistant professor, Department of Pediatrics, NTU, Taipei, Taiwan

2016-now Clinical associate professor, Department of Pediatrics, NTU, Taipei, Taiwan

Expertise:

- *Clinical Genetics*
- *Inborn error of metabolism*
- *Gene therapy*

Professional services and honors:

- *2005 Travel Award. 1st Congress on Asian Society for Pediatric Research (ASPR). November 24-26, 2005 in Tokyo, Japan*
- *2014 Young Investigator Award. 218th biannual meeting of Taiwan Pediatric Association. April 26-27, 2014 in Taipei, Taiwan*
- *2015 Annual Best Reviewer Award, Journal of Formosa Medical Association, Taipei, Taiwan*
- *PI of research projects supported by Ministry of Science and Technology, Taiwan, since 2009*

Recent main publications:

1. ***Lee NC**, Chien YH, Hwu WL. Integrated care for Down syndrome. Congenit Anom (Kyoto). 2016 Feb 11.*
2. *Liu YN, Liu TT, Fan YL, Niu DM, Chien YH, Chou YY, **Lee NC**, Hsiao KJ, Chiu YH. Measuring propionyl-CoA carboxylase activity in phytohemagglutinin stimulated lymphocytes using high performance liquid chromatography. Clin Chim Acta. 2016 Jan 30;453:13-20.*
3. *Li MJ, **Lee NC**, Yang YL, Yen HJ, Chang HH, Chien YH, Lu MY, Jou ST, Lin KH, Hwu WL, Lin DT. Long-term outcome for Down syndrome patients with hematopoietic disorders. J Formos Med Assoc. 2016 Feb;115(2):94-9.*
4. ***Lee NC**, Muramatsu SI, Chien YH, Liu WS, Wang WH, Cheng CH, Hu MK, Chen PW, Tzen KY, Byrne BJ, Hwu WL. Benefits of neuronal preferential systemic gene therapy for neurotransmitter deficiency. Mol Ther. Mol Ther. 2015 Oct;23(10):1572-81.*
5. ***Lee NC**, Chien YH, Wong SL, Sheen JM, Tsai FJ, Peng SF, Leung JH, Chao MC, Shun CT, Hwu WL. Outcome of early-treated type III Gaucher disease patients. Blood Cells Mol Dis. 2014 Sep;53(3):105-9.*
6. ***Lee NC**, Chien YH, Hu MH, Liu WS, Chen PW, Wang WH, Tzen KY, Byrne BJ, Hwu WL. Treatment of congenital neurotransmitter deficiencies by intracerebral ventricular injection of an AAV9 vector. Hum Gene Ther. 2014 Mar;25(3):189-98.*
7. ***Lee NC**, Shieh YD, Chien YH, Tzen KY, Yu IS, Chen PW, Hu MH, Hu MK, Muramatsu S, Ichinose H, Hwu WL. Regulation of the dopaminergic system in a murine model of aromatic L-amino acid decarboxylase deficiency. Neurobiol Dis. 2013 Apr;52:177-90.*
8. *Chen YC, Chien YH, Chen PW, Leung-Sang Tang N, Chiu PC, Hwu WL, **Lee NC**. Carnitine uptake defect (primary carnitine deficiency): risk in genotype-phenotype correlation. Hum Mutat. 2013 Apr;34(4):655. (Corresponding author)*
9. *Hwu WL, Muramatsu S, Tseng SH, Tzen KY, **Lee NC**, Chien YH, Snyder RO, Byrne BJ, Tai CH, Wu RM.Gene therapy for aromatic L-amino acid decarboxylase deficiency. Sci Transl Med. 2012 May 16;4(134):134ra61.*

Amyloid and tau protein as biomarkers for the detection of early degeneration in Down syndrome – comparative study with Alzheimer disease in general population

N.C. Lee[1,2], S.Y. Yang[3,4], J.J. Chieh[3,4,5], Y.H. Chien[1,2], W.L. Hwu[1,2], H.E. Horng[5],M.J. Chiu[6,7]

[1]Department of Pediatrics and [2]Department of Genetic Medicine, National Taiwan University Hospital, College of Medicine

[3]Institute of Electro-optical Science and Technology, National Taiwan Normal University, Taipei 116, Taiwan

[4]MagQu Co., Ltd., Xindian Dist., New Taipei City 231, Taiwan

[5]Department of Electro-optical Engineering, Kun Shan University, Tainan City 710, Taiwan

[6]Department of Neurology, National Taiwan University Hospital, College of Medicine, National Taiwan University, Taipei 100, Taiwan

[7]Graduate Institute of Brain and Mind Sciences, College of Medicine, National Taiwan University, Taipei 100, Taiwan

Background: Abnormal concentrations of β-amyloids and tau had been noted in patients with Alzheimer's disease (AD) and Down syndrome (DS) with AD. However, reports about the changes of these biomarkers in early stage of regression such as behavioral and psychological symptoms of dementia (BPSD) in DS are sparse.

Methods: Seventy-eight healthy control, 62 AD, 35 DS without degeneration, 16 DS with degeneration (DS_D) including 9 BPSD and 7 DS with dementia were enrolled. β-amyloid-40 (Aβ-40), β-amyloid-42 (Aβ-42) and tau protein from blood were analyzed using antibody-labelled functionalized magnetic nanoparticles by measuring superconducting quantum interference device (SQUID) magnetometer. Adaptive Behaviour Dementia Questionnaire (ABDQ) was used to evaluate clinical status of degeneration.

Results: Baseline Aβ-40 and tau is higher but Aβ-42 and Aβ-42/Aβ-40 ratios are lower in DS compared with healthy subjects (all $p<0.001$). In DS_D, a lower Aβ-40 with higher Aβ-42 and Aβ-42/40 ratio were observed compared with DS without degeneration (all $p<0.001$). ABDQ score is negatively correlated with Aβ-40 level ($\rho=-0.556$; $p<0.001$) and tau protein level ($\rho=-0.509$; $p=0.003$) and positively correlated with Aβ-42 ($\rho=0.621$; $p<0.001$) and Aβ-42/40 ratio ($\rho=0.544$; $p<0.001$). Of the markers, Aβ-40, Aβ-42 and Aβ-42/Aβ-40 ratio are good indicators for early detection of degeneration in DS.

Conclusion: Baseline Aβ-40 and tau elevated in DS patients may indicate the chronic neurotoxicity in young DS. Aβ-42 and Aβ-42/40 ratio increased in DS patients with degeneration, indicating the Aβ-42 could be a biomarker for regression in DS subjects. The elevation of baseline tau but decrement in demented DS patients may reflect the burn-out phenomenon in neurodegeneration.

Hwan-Ching Tai, Ph.D.

Assistant Professor

Department of Chemistry

National Taiwan University

Affiliation & Address:

National Taiwan University

1 Roosevelt Road, Section 4, Taipei, Taiwan 106

Phone: + 886 2 3366 8682

E-mail Address: hctai@ntu.edu.tw

Academic background:

Ph.D. Chemistry (2009), California Institute of Technology

B.S. Chemistry (2000), National Taiwan University

Research career:

Assistant Professor (2012.07- present), National Taiwan University.

Postdoctoral Fellow (2010.07- 2012.05), Massachusetts General Hospital and Harvard Medical School. Adviser: Dr. Bradley T. Hyman, MassGeneral Institute for Neurodegenerative Disease and Department of Neurology. Characterization of tau protein misfolding inside neuronal synapses of Alzheimer's disease subjects.

Expertise:

- *Protein damage and protein quality control in age-related disorders:*
  Synaptic pathology in Alzheimer's disease subjects and animal models
  Cellular defense against oxidatively damaged proteins as an anti-aging mechanism
- *Mass spectrometry in proteomics and metabolomics research: methodology development and clinical applications*
- *Material and acoustical properties of antique Italian violins: decoding the secrets of Stradivari violins through material analysis, historical research, and acoustic measurements*

Professional services and honors:

- *Alzheimer's Disease Research Fellowship, American Health Assistance Foundation (2010.07-2012.05)*
- *California Tobacco-Related Disease Research Program Fellowship (2004.04-2007.03)*

Recent main publications:

(A) Original research articles

1. ***Tai, H. C.**; Khidekel, N.; Ficarro, S. B.; Peters, E.C.; Hsieh-Wilson, L. C.* Parallel identification of O-GlcNAc modified proteins from cell lysates. J. Am. Chem. Soc., 2004, 126, 10500-10501.*
2. *Lin, W. Y.; Murugesh, M. G.; Sudhakar, S.; Yang, H. C.; **Tai, H. C.**; Chang, C. S.; Liu, Y. H.; Wang, Y.; Chen, I.W.; Chen, C. H.; Luh, T. Y.* On the rigidity of polynorbornenes with dipolar pendant groups. Chem. Eur. J., 2005, 12, 324-330.*
3. ***Tai, H. C.**; Besche, H.; Goldberg, A. L.; Schuman, E. M.* Characterization of the brain 26S proteasome and its interacting proteins. Front. Mol. Neurosci. 2010, 3, 12.*
4. *Koffie, R. M.; Hashimoto, T.; **Tai, H. C.**; Serrano-Pozzo, A.; Joyner, D.; Hou, S.; Kopeikina, K. J.; Frosch, M. P.; Lee, V. M.; Holtzman, D. M.; Hyman, B. T.; Spires-Jones, T. L.* Apolipoprotein E4 effects in Alzheimer's disease are mediated by synaptotoxic oligomeric amyloid-beta. Brain, 2012, 135, 2155-68.*
5. ***Tai, H. C.**; Serrano-Pozo, A.; Hashimoto, T.; Frosch, M. P.; Spires-Jones, T. L.; Hyman, B. T.* The synaptic accumulation of hyperphosphorylated tau oligomers in Alzheimer disease is associated with dysfunction of the ubiquitin-proteasome system. Am. J. Path., 2012, 181, 1426-1435.*
6. *Taylor, A. M.*; Wu, J.; **Tai, H. C.**; Schuman, E. M.* Axonal translation of β-catenin regulates synaptic vesicle dynamics. J. Neurosci., 2013, 33, 5584-5589.*
7. *Kopeikina, K. J.; Polydoro, M.; **Tai, H. C.**; Yaeger. E.; Carlson, G. A.; Pitstick, R.; Hyman, B. T.; Spires-Jones, T. L.* Synaptic alteration in the rTg4510 mouse model of tauopathy. J. Comp. Neurol. 2013, 521, 1334-1353.*
8. *Perez-Nievas, B. G.; Stein, T.; **Tai, H. C.**; Dols-Icardo, O.; Scotton, T. C.; Barroeta-Espar, I.; Fernandez-Carballo, L.; de Munain. E. L.; Perez, J.; Serrano-Pozo, A.; Frosch, M. P.; Lowe, V.; Parisi, J. E.; Petersen, R. C.; Ikonomovic, M. D.; Lopez. O. L.; Klunk, W.; Hyman, B. T.; Gomez-Isla, T.* Dissecting phenotypic traits linked to human resilience to Alzheimer's pathology. Brain, 2013, 136, 2510-2526.*
9. ***Tai, H. C.***; Wang, B. Y.; Serrano-Pozo, A.; Frosch, M. P.; Spires-Jones, T. L.; Hyman, B. T.* Frequent and symmetric deposition of misfolded tau oligomers within presynaptic and postsynaptic terminals in Alzheimer's disease. Acta Neuropath. Commun., 2014, 2, 146.*
10. *Huang, C. F.; Liu, Y. H.; **Tai, H. C.*** Synthesis of peptides containing 2-oxohistidine residues and their characterization by liquid chromatography-tandem mass spectrometry. J. Pept. Sci., 2015, 21, 114-119.*
11. *Yang, C. I.; Tsai, B. N.; Huang, S. J.; Wang, T.Y.; **Tai, H. C.**; Chan, J. C.* Aggregation of Beta-Amyloid Peptides Proximal to Zwitterionic Lipid Bilayers. Chem. Asian J. 2015, 10, 1967-1971.*

(B) Reviews and commentary articles

1. ***Tai, H. C.**; Schuman, E. M.* MicroRNA: MicroRNAs reach out into dendrites. Curr. Biol., 2006, 16, R121-123.*
2. ***Tai, H. C.**; Schuman, E. M.* Ubiquitin, the proteasome and protein degradation in neuronal function and dysfunction. Nat. Rev. Neurosci., 2008, 9, 826-838.*
3. ***Tai, H. C.**; Schuman, E. M.* Angelman syndrome: Finding the lost Arc. Cell, 2010, 140, 608-610.*
4. *Chen C. C.; Su, W. C.; Huang, B. Y.; Chen, Y. J.; **Tai, H. C.***; Obena, R. P.* Interaction modes and approaches to glycopeptide and glycoprotein enrichment. Analyst, 2014, 139, 688-704.*

(C) Violin research articles

1. ***Tai, H. C.*** *Stradivari's varnish: A review of scientific findings, Part 1. Journal of the Violin Society of America: VSA Papers, 2007, 21 (1), 119-144.*
2. ***Tai, H. C.*** *Stradivari's varnish: A review of scientific findings, Part 2. Journal of the Violin Society of America: VSA Papers, 2009, 22 (1) 60-90.*
3. ***Tai, H. C.**; Chung, D. T. Stradivari violins exhibit formant frequencies resembling vowels produced by females. Savart Journal, 2012, 1 (2), online article.*
4. ***Tai, H. C.*** *Role of timbre memory in evaluating Stradivari violins. Proc. Natl. Acad. Sci. USA, 2014, 111, E2777-2778.*

Synaptic pathology in Alzheimer's disease and its link to biomarker discovery

Hwan-Ching Tai

Department of Chemistry, National Taiwan University, Taipei, Taiwan

The best neurological correlate of dementia in Alzheimer's disease (AD) is the loss of synapses, stronger than neuronal loss and the deposition of plaques and tangles. Therefore ideal biomarkers for AD should reflect pathophysiological changes at brain synapses. The neocortex and limbic system contain trillion of synapses, averaging about 500 nm in size, making them very difficult to study. We have traditionally relied on the investigation of synapses from other mammalian species to infer about the compositions and properties of our own synapses, but it is questionable whether such extrapolation is applicable to complex neurological disorders of sporadic nature such as AD. Without direct measurements of molecular properties from synapses of AD subjects, we are unlikely to correlate existing or future biomarkers with the critical aspect of AD neuropathology concerning synaptic dysfunction.

Our laboratory is developing a series of techniques to analyze brain synapses isolated from frozen human or rodent tissues. We have captured individual synapses over glass surfaces and applied immunocytochemistry to examine protein localization. We have ascertained the pre- and post-synaptic localization of normal and abnormal tau in human subjects, and begun to apply super-resolution optical techniques to visualize synaptic tau at 30 nm resolution. We have devised novel protocols to conduct high-throughput synapse analysis using flow cytometers and cell sorters, which allowed us to establish ApoE as a synaptically enriched protein. This will also allow us to collect a million highly purified synapses carrying specific marker sets, which can be further studied by ultrastructural imaging and next-generation sequencing for transcriptomics. By shotgun proteomics methods, we have established early-phase tau hyperphosphorylation sites in the synapses of APP/PS1 mice, and identified CDK5 as the critical tau kinase downstream of beta amyloid. We would also like to explore the synaptic metabolomics changes under AD, using liquid chromatography combined with fluorescence and mass spectrometry detection. Using a combination of isolation, visualization, and multi-omics approaches, we hope to understand the pathogenesis and progression of synaptic dysfunction in AD, which may be an important basis for future biomarker and therapeutic discoveries.