人物介紹

台大獸醫學院-繁殖生理與細胞生物學研究室
(Reproductive Physiology and Cell Biology)

蔡沛學助理教授

本研究室為2014年4月開始設立，歡迎生物醫學相關科系（獸醫與非獸醫學系均可）並對繁殖生理 (Reproductive Physiology) 與细胞生物學 (Cell Biology) 有興趣之同學加入本研究室。

蔡沛學助理教授2000年 畢業於中興大學獸醫學系，並取得獸醫師執照與通過專技高考。2002-2010年於荷蘭烏特列支大學（Utrecht University）生化與細胞生物學系先後取得碩、博士學位。碩士期間以流行病學角度，探討 DNA deficiency 對繁殖之影響；並於 Dr. Bart Gadella 實驗室完成博士論文 (2010)。研究主題為細胞膜蛋白動力學（Membrane protein dynamics）於生殖醫學領域之角色，尤其專注於哺乳類 SNARE 蛋白在生殖細胞膜融合 (membrane fusion) 之作用機轉。

2010-2014年間， 蔡沛學助理教授先後於荷蘭烏特列支大學 (with Dr. Bart Gadella) 、美國麻州大學醫學院 (with Dr. Harvey Florman) 與哈佛醫學院 (with Dr. Dennis Brown and Dr. HA Jenny Lu) 進行博士後研究。主題延續膜蛋白動力學之基礎醫學研究及應用。

本研究室研究重點將致力於建構細胞膜蛋白動力學研究之實驗動物模型，以期提供不孕症與特定疾病之檢測或治療應用契機。

Research Interests (Tsai Lab)

Cell membrane is one of the most active components of a cell. A constant reorganization of cell membrane and membrane surface proteins are required to maintain vital biological phenomena, such as wound repair, cell growth and differentiation as well as cell-cell interactions. My lab is a newly established lab (from April 2014) at the faculty of Veterinary Medicine, National Taiwan University. Our main interest is to understand how membrane surface dynamics (e.g bi-directional protein trafficking across cell membrane) effect (1) gamete maturation/interactions, and (2) disease progression, and more importantly, how these processes are regulated. We apply various approaches including (1) cell culture (both stable cell lines and primary cells on 2D and 3D culture), (2) biochemistry, (3) proteomic, (3) the use of transgenic animals and (4) *in vivo* animal models in order to visualize the dynamics of membrane activities. Details of our research interests are described below.

Interest #1: To investigate novel roles and unconventional functions of a classic water channel protein aquaporin 2 (AQP2)

The kidney performs a number of essential roles including clearance of endogenous waste products, maintaining electrolyte, acid/base and water homeostasis. Chronic kidney disease (CKD) together with acute kidney disease (AKD) manifested by tubular damage and/or dysfunction has an estimated prevalence of > 20% worldwide. In Taiwan, the high prevalence rate (~12%) and the low disease awareness have position Taiwan among those countries with high incidence and prevalence rates for end-stage renal disease. Kidney diseases also stand at the nation's fifth leading cause in hospitalized patients at the clinic and tenth leading cause of death. Therefore, understand mechanisms behind kidney tubular development, repair and regeneration after injury is critically important. Aquaporin 2 (AQP2), a classic water channel protein expressed in kidney collecting ducts (CD) is central to vasopressin (VP) regulated water homeostasis in mammals.

Interest #2: To investigate paternal (sperm)-maternal (oocyte, oviduct) protein and vesicle exchange and interactions upon sperm transit in the female genital tract and upon sperm-oocyte fusion.

Fertilization is a decisive moment in life and enables the combination of the two gametes to ultimately form a new organism. The sperm surface, especially on the head area has different subdomains that are involved in the distinct parts of the fertilization process. This sperm head surface is subject to continuous remodelling during epididymal maturation of sperm and sperm migration in the male and female genital tracts. Intriguingly however, the identity, origin and spatial ordering of proteins at the sperm surface that are involved in mammalian fertilization are essentially unknown. The surface reorganisation continues until the sperm resides in fallopian tube where it meets and may fertilize the oocyte. A selective process will favour functional mature and intact sperm to optimally interact and fertilize the oocyte. Even the peri-vitelline fluid, between the zona pellucida (ZP) and the oolemma (the oocyte's plasma membrane), is involved in sperm surface remodelling and contains factors which could facilitate the first penetrating sperm to fertilize the oocyte. Understanding gamete interactions upon fertilization and to correlate the defects of these processes to their clinical relevance for the increasing infertility complications is therefore important for reproductive biologists. However, our lack of knowledge of the conditions and mechanisms in *in vivo* fertilization represents a gap in our understanding of reproduction. My lab hopes to bridge this gap using currently available techniques and to develop novel approaches and techniques in order to visualize and to advance the understanding of fertilization progresses in detail *in vivo*. Our research focuses of this project are (1) to investigate gamete interactions and paternal-maternal material [protein and vesicles] exchange upon fertilization (2) understand gamete recognition and fusion (both intracellularly and intercellularly), (3) whether typically ordered cytoskeletal elements of the sperm are reflecting or facilitating the lateral domain structure and the redistribution of essential proteins (for sperm-oocyte fusion and interactions) on the sperm surface.