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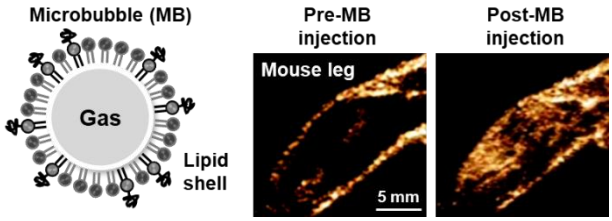
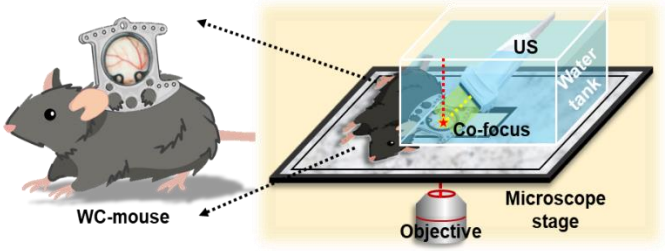
研究興趣

超音波為臨床醫學之常規影像診斷工具，其具備即時造影、良好的穿透與聚焦深度、無輻射傷害等優點，被廣泛運用在診斷與治療的追蹤。運用超音波遇到空氣會產生強反射訊號，呈現高對比影像的特性，微氣泡(microbubble, MB)成為超音波對比劑，其使用生物相容性材料(磷脂質、白蛋白、聚合分子)作為殼層，內部包覆疏水性的氣體，製備出直徑小於十微米的氣泡，經由靜脈注射可在超音波影像上，提供精準的微血管分布與血流資訊，可有效診斷心血管疾病與腫瘤位置。



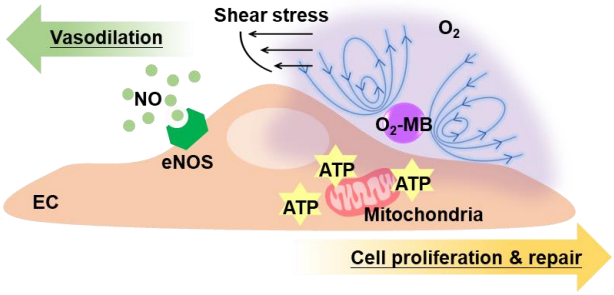
超音波除了可提供診斷影像資訊外，調節其所發射出的聲波能量、聚焦點位置，亦可運用在精準治療上。微氣泡受到超音波照射時，會因為聲波壓力差的變化，而有壓縮、膨脹的現象，稱為穴蝕作用，此現象可影響周遭環境與細胞組織，提升細胞膜或局部血管通透性(血腦屏障開啟)，增加藥物或基因遞送的效率。當超音波能量超過一定強度時，微氣泡會劇烈脹縮甚至破裂，可直接破壞細胞／血管，以物理治療的方式抑制腫瘤生長。此外，微氣泡還可做為藥物載體，攜帶化療藥物、基因片段、治療氣體等，以體外超音波刺激的方式，進行局部藥物控制釋放，配合細胞血管通透性的提升，促進藥物進入到細胞組織中進行治療。

實驗室主要運用超音波搭配多功能對比劑(微氣泡、相變液滴、超疏水材料等)，達到局部施加物理力與氣體／藥物控制釋放之效果，治療腫瘤與心血管疾病，並進一步運用小動物模型與細胞實驗，探討超音波所造成的生理機制。



➢ **心血管疾病治療**

下肢缺血、心肌梗塞、腦中風等小動物模型，以超音波搭配攜帶氧氣之微氣泡，於受損血管進行局部治療，調控血管內皮細胞之生理機制，促進受損血管進行修復，並以物理力刺激血管舒張，將低二次血栓的機率，預防急性缺血之再灌注損傷，保護心肌組織與腦神經功能。

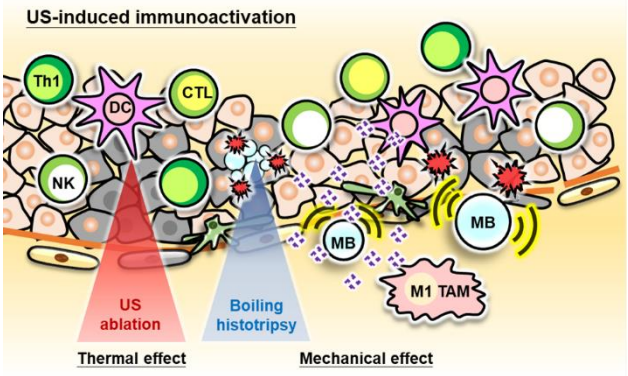


➢ **調控腫瘤微環境**

使用攜帶氧氣與化療藥物之微氣泡，搭配聚焦式超音波於腫瘤位置局部釋放氧氣與藥物，改善腫瘤缺氧，抑制缺氧產生的腫瘤抗藥性，並調控腫瘤微環境，誘發腫瘤血管正常化，改善血管結構與功能，提升藥物遞送效率並抑制腫瘤轉移。*(Ho, Y. J., Theranostics, 2019)*

➢ **腫瘤免疫治療**

超音波可產生熱或機械力，分別用於腫瘤熱消融或結合超音波對比劑增強物理破壞力，局部破壞腫瘤組織或血管，並增加有效抗原活化免疫細胞，達到腫瘤免疫治療的效果。*(Ho, Y. J., J Control Release, 2020)*



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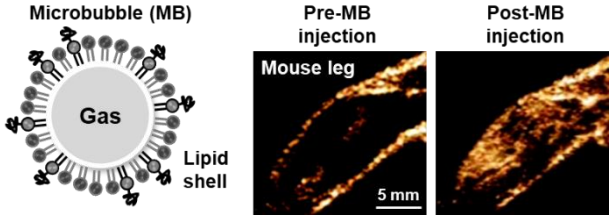
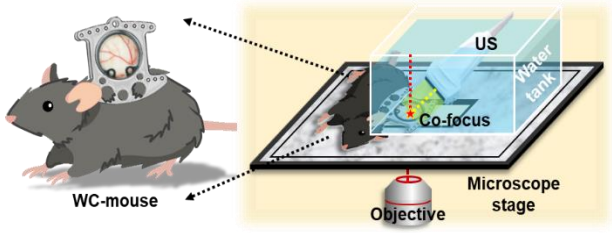
Research Interests

Ultrasound (US) imaging is one of the frontline diagnostic tools in clinic. Since US reflects high intensity signal at the interface of gas and shows contrast enhanced imaging, microbubble (MB) is designed to be the US contrast agent. MBs contain biocompatible shell and gaseous core. After i.v. injection, MBs (<10 μm) provide microvascular distribution and blood perfusion information for cardiovascular disease and tumor location diagnosis.



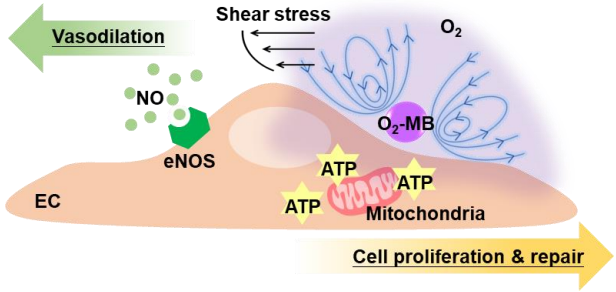
The effect of MB expansion and compression under US stimulation, called MB cavitation, can enhance cells and vascular permeability to promote drug/ gene delivery. Moreover, MBs can be used as drug carriers to deliver drugs, genes, and therapeutic gases and locally release triggered by US stimulation. US-stimulated MB cavitation provides not only real-time imaging tracing, but also local drug release and cell permeability enhancement to improve treatment outcome, which could be a potential theranostic application in the development of precision medicine.

Theranostic ultrasound Lab is focused on the medical applications of US and contrast agents. The local mechanical force and drug release triggered by US-stimulated MB cavitation are investigated. The animal model and cell experiments are used to evaluate the biological mechanism and treatment outcome in tumor and cardiovascular disease.



➢ Cardiovascular disease therapy

The local therapy at an injured vessel via US with oxygen-loaded MBs promotes endothelial cell repair and vasodilation to prevent secondary thrombosis.



➢ Tumor microenvironment

Local oxygen release by US with oxygen-loaded MBs reduces tumor hypoxia to induce vascular normalization increasing the efficiency of drug delivery. (*Ho, Y. J., Theranostics, 2019)*

➢ Immunotherapy

US ablation or mechanical force induced by MB cavitation generates antigens to activate immune cells for anti-tumor immunotherapy. *(Ho, Y. J., J Control Release, 2020)*