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On CEUS and sonoporation



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Ultrasonic imaging is becoming the most popular medical imaging modality, owing to the low price per examination and its safety. A B-mode ultrasound scan shows contrasted regions from transitions in acoustic impedance, i.e., transitions in tissue type, in the form of brighter pixels. However, blood is a poor scatterer of ultrasound waves at clinical diagnostic transmit frequencies, which lie between 1 and 40 MHz. For perfusion imaging, markers have been designed to enhance the contrast in B-mode imaging. These so-called ultrasound contrast agents consist of microscopically small gas bubbles encapsulated by biodegradable shells. Contrast-enhanced ultrasound (CEUS) represents a significant advancement in the evaluation of angiogenesis in digestive cancers. Particularly, for the study of focal liver lesions, CEUS has been widely used for detection and characterisation of malignancy. The unique feature of CEUS of non-invasive assessment in real-time liver perfusion throughout the vascular phases has led to a great improvement in diagnostic accuracy of ultrasound, but also in guidance and evaluation of responses to therapy. It has been proven by numerous groups, that the cellular uptake of drugs and genes is increased, when the region of interest is under sonication, and even more so when a contrast agent is present. This increased uptake has been attributed to the formation of transient porosities in the cell membrane, which are big enough for the transport of drugs into the cell. The transient permeabilisation and resealing of a cell membrane is called sonoporation. In this presentation, the physical principles of ultrasound contrast agent microbubble behaviour and their adjustments for imaging and drug delivery including sonoporation are described.

