

# OXFORD UNIVERSITY: LICENCE TO SHOOT BUBBLES

We have experienced various podcasts and read various articles on targeted drug delivery mechanisms, including the use of liposomes, micelles and dendrimers, biodegradable particles as well as nanotechnology. Nonetheless, one of the more recent revelations is the use of microbubbles to increase the bioavailability and in parallel, decrease the adverse effects of treatment. This technology is being spearheaded by a biomedical engineer, Prof. Eleanor Stride hailing from Oxford University. Basically, the bubbles currently being investigated are similar to the soap bubbles generated by the bubbleblowers which we find in the hands of children at our summer feasts.

This technology revolves around the use of ultrasound. A gas (such as fluorocarbon) and the active ingredient which we are interested in are bubbled into a liquid which contains the coating material (such as phospholipids). The mixture is then agitated by using ultrasound in order to generate a foam. 1-4µm microbubbles are then extracted from this foam. In essence, each microbubble consists of a phospholipid layer surrounding a fluorocarbon core, with the active ingredient situated either within the phospholipid layer or attached to it.

The bubbles produce a strong echo on ultrasound, so following parenteral administration, ultrasound is used to track the bubble inside the body. The drug stays in the bubble until it is released - also by ultrasound - onto the site of action. The

mechanism of release is simple. Since the bubbles are filled with a gas, when they are exposed to ultrasound, they expand and contract. Thus, if the ultrasound power is gradually increased, the bubbles will eventually rupture, releasing the active ingredient. **By varying the ultrasound power, the amount of drug released can also be controlled.** Interestingly, some bubbles can be loaded with magnetic nanoparticles so they can be moved to the target site with an external magnetic field. Obviously this technology poses various challenges, the most important of which is microbubble uniformity since this will determine the accuracy of the dosing.

This technology also appears to simultaneously make cells more permeable, thus increasing the bioavailability of the active ingredient. This effect is not completely understood, however it seems to result from a combined effect of ultrasound and the aforementioned mode of delivery. Till now, this technology has been successfully studied in mouse models. The next step is clinical trials.

Now, close your eyes ... and imagine the application of this technology in myocardial infarction ... or oncology ... or ... ❄

*Pan Ellis*