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Revisiting the potential for bursting bubbles to damage cells below the free surface[1] PETER WALLS, JAMES BIRD, Boston University — The rapid motion associated with bubbles bursting at the surface of a liquid is known to cause damage to cells in a suspension, which is particularly problematic in bioreactors that require continuous injection of oxygen to sustain the cells. It is generally accepted that cells directly attached to the bubble's interface will experience lethal levels of damage. To prevent cells from initially attaching to the bubble's surface, surfactants are widely used. However, the potential for bursting bubbles to damage nearby, but not directly attached, cells is less clear. Previous numerical studies have predicted maximum energy dissipation rates (EDR) as high as 10^{10} W/m^3 for bubbles with radii less than 1 mm; lethal to the commonly used mammalian CHO cell. Here we show that these studies tend to underestimate the generated EDR levels by several orders of magnitude due to limited numerical mesh resolution. Furthermore, we demonstrate how a downward traveling jet can cause damage away from the interface. We validate our numerical model with high-speed bubble bursting experiments and relate the dynamics of this downward jet to the boundary layer equations. We anticipate our results will be an integral step towards developing more efficient aeration platforms.

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