Supplementary Information

Light-triggered Explosion of Lipid Vesicles

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I. SUMMARY OF THE LITERATURES

TABLE S1 Summary of previous literatures and highlights of the present work on vesicle dynamics under light-induced osmotic shock.

Straining Method	Dynamics	D/S[1]	Th/E[2]	References
Light-induced membrane structure change	Pulsatile	D	Th + E	[1]
Light-induced membrane structure change	Pulsatile	D	Th	[2]
Light-induced membrane structure change	Pulsatile	D	Th + E	[3]
Light-induced osmotic imbalance	Exploding	-	E	[4]
Light-induced osmotic imbalance	Exploding	-	E	[5]
Light-induced osmotic imbalance	Pulsatile Exploding	S	Th	Present work

[1] D/S: Deterministic/Stochastic approach for pore formation

[2] Th: Theory, E: Experiments

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II. SAMPLING MEMBRANE LYTIC TENSION

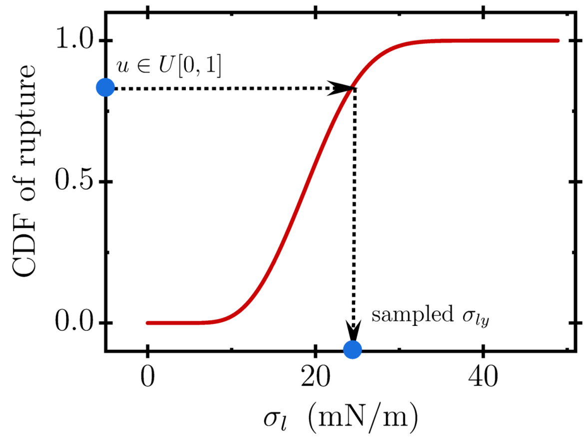

Figure S1 Sampling of membrane lytic tension. The solid red line is CDF of rupture. First, draw a random number $u \in U[0,1]$. Next, invert the CDF such that $\sigma_l = P_r(u)$.

Here we use a Inverse Transformation Method to draw samples from the probability distribution of σ_l to determine the lytic membrane tension for the current swell-burst-reseal cycle (Fig. S1). The steps of the algorithm are as follows [6]

a) obtain a cumulative probability distribution function (CDF) of membrane ruptutre, $P_r = 1 - S$. Here S is survival probability of membrane as formulated in Eq. 1 (main text). Note that S depends on the $\dot{\sigma}$, hence the distribution will change for each cycle.

b) draw a random number, $u \in U[0,1]$ where $U[0,1]$ is a uniform distribution.

c) invert the CDF to determine the membrane lytic tension for the current cycle as $\sigma_l = P_r(u)$.

III. MATERIAL PROPERTIES USED IN THE MODEL VALIDATION WITH THE EXPERIMENTAL DATA IN [7]

The material properties used in the simulations to plot Figs. 2 a-b,d (main text) are listed in Table S2. The fitting value of the prepore radius, $r_\delta = 0.41$ nm is within the typical range in the literatures [8, 9].

TABLE S2 Material properties of POPC bilayers

Parameter	Values	References
R_0	8, 14, 20 μm	[7]
c_0	0.2 M	[7]
d	3.5 nm	[7]
γ	8.6 pN	[10]
k_b	7×10^{-20} J	[11]
K	0.17 N/m	[12]
ν_s	18.04×10^{-6} m^3/mol	[7]
η_s	0.001 Pa $\cdot$ s	[7]
η_m	5×10^{-9} N $\cdot$ s/m	[7]
P	20 μm/s	[7]
$D_{sucrose}$	5 $\times10^{-10}$ m^2/s	[13]
r_δ	0.41 nm	Present work

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