Electronic Supplementary Material (ESI) for RSC Advances.

Electronic Supplementary Information

Shape Effect on Polymer Nanoparticle Transport in a Blood Vessel

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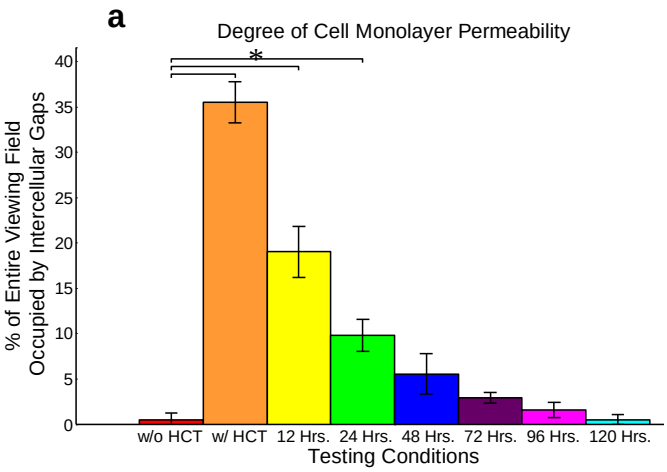
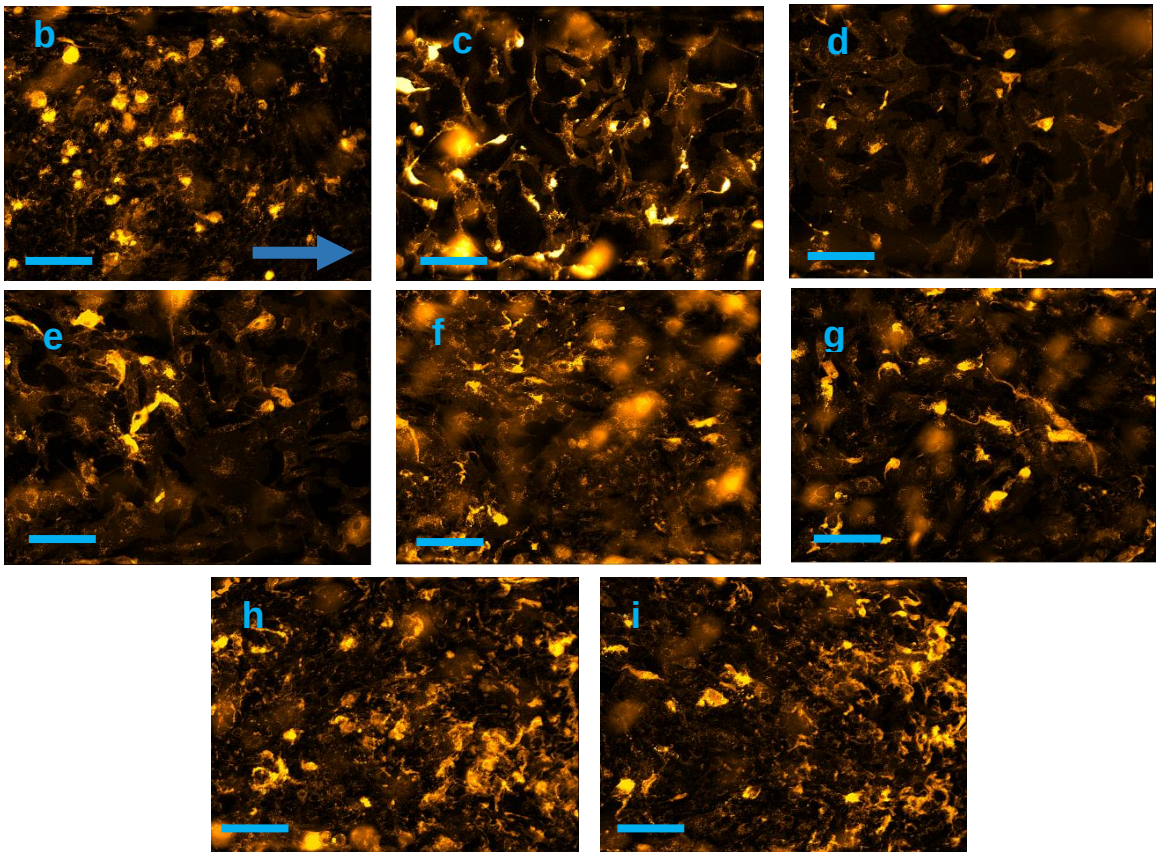
Figure S1. Normalized percentage of BAOEC monolayer permeability under various culturing conditions. Data shown as sum of means ± S.D. (n=5 independent microfluidic devices) & representative fluorescence images of BAOEC stained with CellMask™ Orange plasma membrane stain. BAOECs are grown within microfluidic device and subjected to various conditions.

a, Percentage of intercellular gap coverage without HCT116s, with HCT116s, after treatment with Paclitaxel for 12hrs., after treatment with Paclitaxel for 24hrs., after treatment with Paclitaxel for 48hrs., after treatment with Paclitaxel for 72hrs., after treatment with Paclitaxel for 96hrs., and after treatment with Paclitaxel for 120hrs., measured as a percentage of the entire imaging field, collected via standard fluorescent microscopy. One way ANOVA statistical analysis with Tukey equal variances assumed, along with tests of homogeneity of variance verified by Brown-Forsythe and Welch analyses. $F_{7,32}$ = 661.92. Statistical significance indicated by * brackets in both plots at $p \leq 0.05$. Sample collection was carried out from 5 independent devices (biological replicates). All statistical tests have been justified as appropriate. **b,** BAOECs grown in confluent monolayer. **c,** BAOEC monolayer after exposure to HCT116s present in basal channel. **d,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 12 hrs. **e,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 24 hrs. **f,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 48 hrs. **g,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 72 hrs. **h,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 96 hrs. **i,** BAOEC monolayer after treatment of HCT116s with Paclitaxel for 120 hrs. All scale bars are 50µm in length and direction of flow in all images is represented by blue arrow.





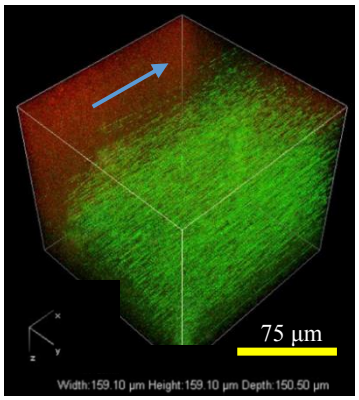
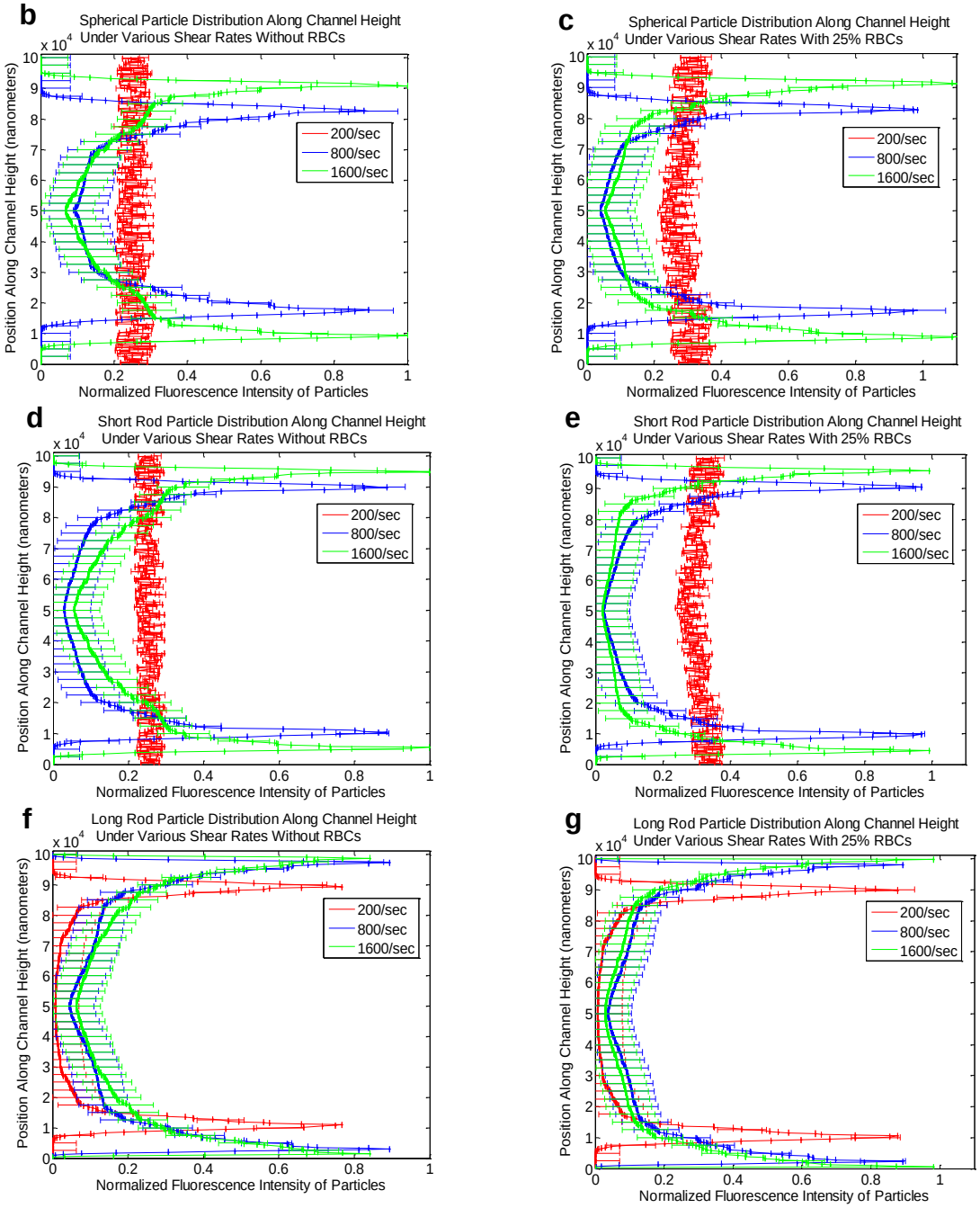


Figure S2. Representative image collected during particle flow tests & normalized particle concentration distributions under various shear rates and blood conditions. Data shown as sum of means ± S.D. (n=5 independent microfluidic devices).

a, 3-Dimensional particle distribution confocal scan depicting traces of particle paths during flow and particle locations. Scale bar is 75µm and blue arrow indicates direction of flow. **b,** Spherical distribution at various shear without RBCs. **c,** Spherical distribution at various shear with 25% RBCs. **d,** Short Rod distribution at various shear without RBCs. **e,** Short Rod distribution at various shear with 25% RBCs. f**,** Long Rod distribution at various shear without RBCs. **g,** Long Rod distribution at various shear with 25% RBCs.



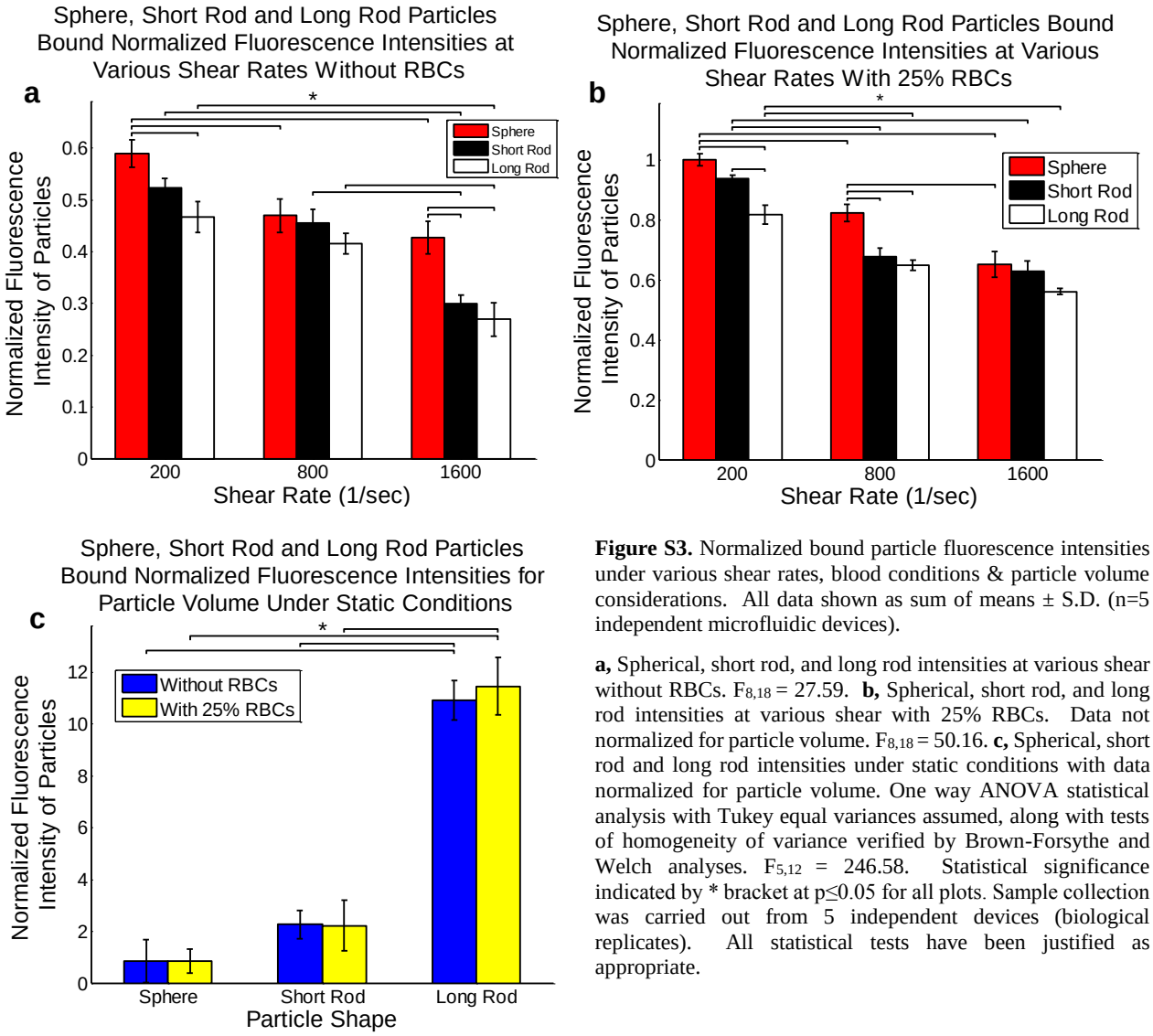


Figure S3. Normalized bound particle fluorescence intensities under various shear rates, blood conditions & particle volume considerations. All data shown as sum of means ± S.D. (n=5 independent microfluidic devices).

a, Spherical, short rod, and long rod intensities at various shear without RBCs. $F_{8,18} = 27.59$. **b,** Spherical, short rod, and long rod intensities at various shear with 25% RBCs. Data not normalized for particle volume. $F_{8,18} = 50.16$. **c,** Spherical, short rod and long rod intensities under static conditions with data normalized for particle volume. One way ANOVA statistical analysis with Tukey equal variances assumed, along with tests of homogeneity of variance verified by Brown-Forsythe and Welch analyses. $F_{5,12} = 246.58$. Statistical significance indicated by * bracket at $p \leq 0.05$ for all plots. Sample collection was carried out from 5 independent devices (biological replicates). All statistical tests have been justified as appropriate.

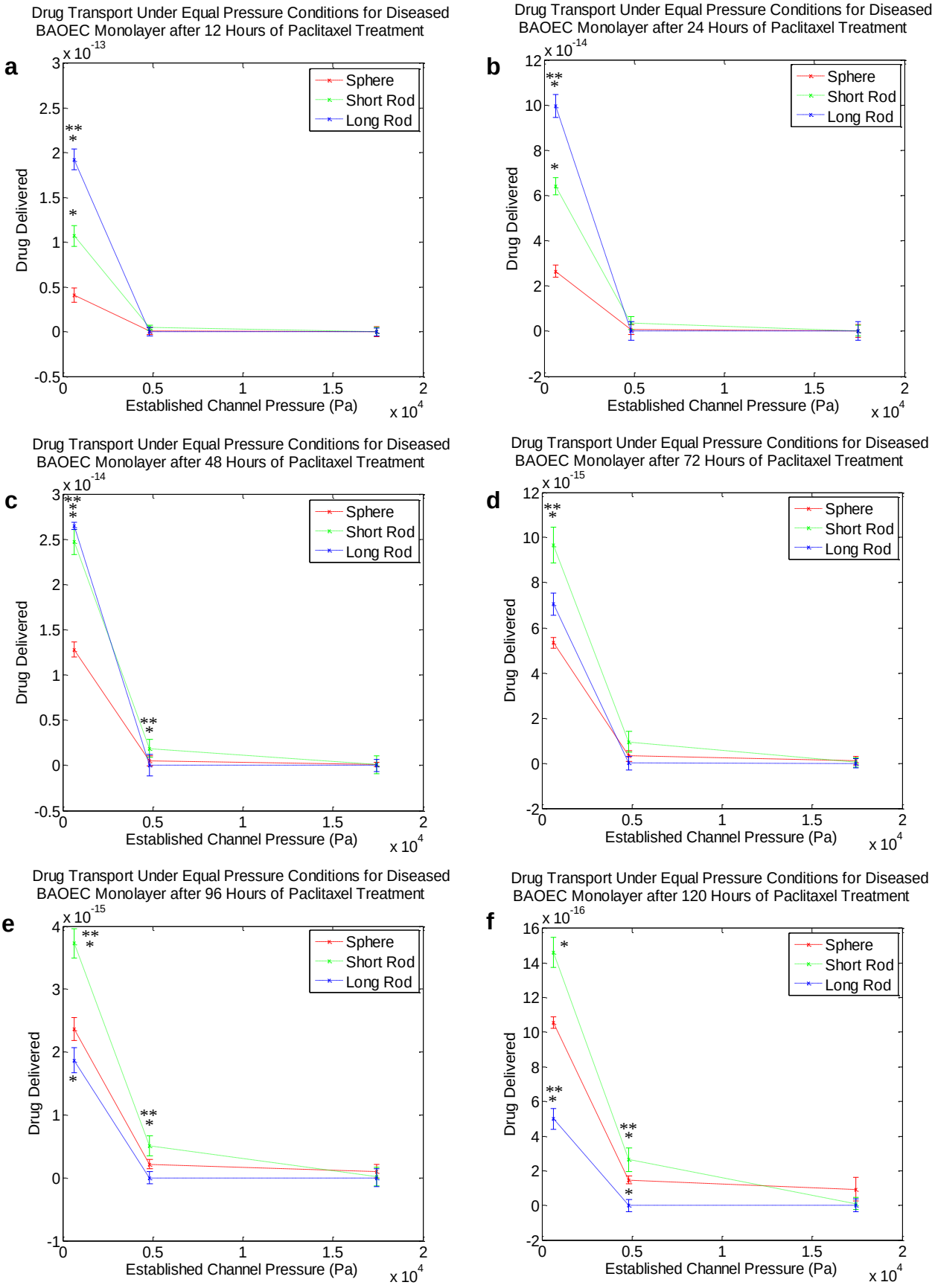

a
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 12 Hours of Paclitaxel Treatment
x 10^-13
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod
b
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 24 Hours of Paclitaxel Treatment
x 10^-14
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod
c
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 48 Hours of Paclitaxel Treatment
x 10^-14
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod
d
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 72 Hours of Paclitaxel Treatment
x 10^-15
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod
e
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 96 Hours of Paclitaxel Treatment
x 10^-15
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod
f
Drug Transport Under Equal Pressure Conditions for Diseased BAOEC Monolayer after 120 Hours of Paclitaxel Treatment
x 10^-16
Drug Delivered
Established Channel Pressure (Pa)
x 10^4
Sphere
Short Rod
Long Rod

Figure S4. Normalized drug transport for various particle shapes and pressures during Paclitaxel treatment time-course. Data shown as sum of means ± S.D. (n=5 independent microfluidic devices).

a, Normalized drug transport for particle shapes 12hrs. into treatment. $F_{8,18} = 276.10$. **b,** Normalized drug transport for particle shapes 24hrs. into treatment. $F_{8,18} = 1054.86$. **c,** Normalized drug transport for particle shapes 48hrs. into treatment. $F_{8,18} = 2998.76$. **d,** Normalized drug transport for particle shapes 72hrs. into treatment. $F_{8,18} = 84.36$. **e,** Normalized drug transport for particle shapes 96hrs. into treatment. $F_{8,18} = 572.99$. **f,** Normalized drug transport for particle shapes 120hrs. into treatment. $F_{8,18} = 494.04$. All data normalized for particle volumes. One way ANOVA statistical analysis with Tukey equal variances assumed, along with tests of homogeneity of variance verified by Brown-Forsythe and Welch analyses. Statistical significance between short rod/long rod and sphere (control) indicated by * at $p \leq 0.05$ & statistical significance between short rod and long rod indicated by ** at $p \leq 0.05$. Sample collection was carried out from 5 independent devices (biological replicates). All statistical tests have been justified as appropriate.