Supplementary Fig 1. Dynamics of neural cell growth in the neural compartment chamber. The cells appeared rounded during early stages of growth (Day 0-1) and slowly started extending processes by Day 3. By Day 10, the cells were completely confluent with several neuronal and glial processes as seen in the bottom right image. Day 1 and 3 Scale Bar = 100 μm, Day 10 Scale Bar = 50 μm
Supplementary Fig. 2. Differences in neuronal population density in MAP-2+ cells (both left and right images are stained with MAP-2) with and without serum at the same seeding density $5 \times 10^5$ cells/cm$^2$. The addition of serum to our neuroglial cultures (Suppl. Fig. a) generated more glial cells (especially astrocytes) and hence lower neuronal population indicated by multiple DAPI (blue) cells that were negative to MAP-2 in (Suppl. Fig. a). However, we observed significantly lower DAPI+/MAP2- cells in our cultures without serum (Suppl. Fig. b). The caveat of the serum-free system was that these cultures showed substantial cell death when exposed to our vascular endothelial channel cell layer during our co-culture experiments and hence we adhered to our serum-containing media for our neurovascular co-cultures.
**Supplementary Fig. 3.** Proof of concept of high-resolution microscopy in the modular device for visualizing sub-cellular features. The images were captured with a 100× oil immersion objective with 1.6× times magnification (160×) on Deltavision Core (Applied Precision, Issaquah, WA) microscope. Cells in the neural chamber were grown for 4 days and stained with Mitotracker™ (red) and Hoechst 33342 (blue) live stains as shown in a, b, and d. The mitochondriae and nuclear content are evidently visible in these images (which a membrane-insert cup system does not offer) indicating the potential of using the device for high-content analysis to observe changes in sub-cellular pharmacodynamics. Scale bar on all images = 5 μm.