Lab on a Chip

SUPPLEMENTARY INFORMATION

Neural probes with multi-drug delivery capability

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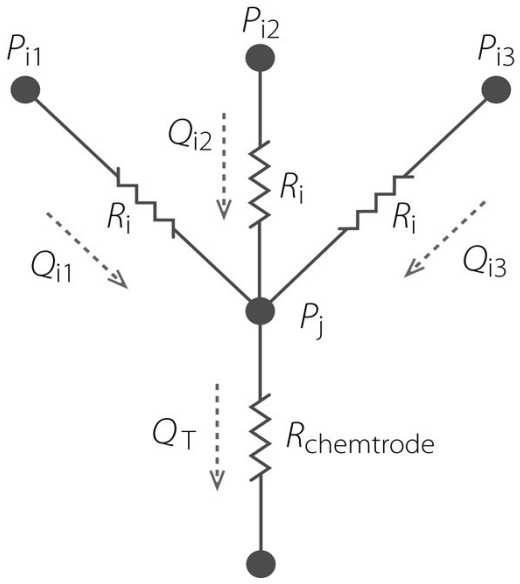

Fig. S1 Resistance modelling of the microfluidic chip integrated with the chemtrode. *P* is the pressure applied at the input, *Q* is the flow rate, and *R* is the hydraulic resistance. The derivation shows that the flow rates should be the same regardless of the number of inputs used as long as the sum of input pressures is the same.

At a junction, sum of inlet flow rates is junction flow rate.

$$Q_{i1} + Q_{i2} + Q_{i3} = Q_j$$

$$\left(\frac{P_{i1} - P_j}{R_{i1}} + \frac{P_{i2} - P_j}{R_{i2}} + \frac{P_{i3} - P_j}{R_{i3}}\right) = \frac{P_j}{R_{chemtrode}}$$

$$P_j = \frac{(P_{i1} + P_{i2} + P_{i3})}{\left(\frac{R_i}{R_{chemtrode}} + 3\right)}$$

Total flow rate to the outlet of the chemtrode is

$$Q_T = \frac{P_j}{R_{chemtrode}} = \left(\frac{1}{R_i + 3R_{chemtrode}}\right)(P_{i1} + P_{i2} + P_{i3})$$

Since both R_i and $R_{chemtrode}$ are constant, the total flow rate is proportional to sum of 3 input pressure value.

Table S1. Summary of the input pressure values used for multiplexing 1 and 2 drugs.

Multiplexing (Inlet 1 : Inlet 2 : Inlet 3)	P1 (kPa)	P2 (kPa)	P3 (kPa)	P1 + P2 + P3 (kPa)	Flow Rate (nl/min)
1 : 0 : 0	60	40	40	140	230
0 : 1 : 0	40	60	39	139	220
0 : 0 : 1	40	40	60	140	245
1 : 1 : 0	50	50	40	140	209
3 : 1 : 0	55	45	40	140	212
1 : 3 : 0	45	55	40	140	223

** Note: Given that the sum of three input pressures is the same (i.e. 140 kPa), the flow rates are the same regardless of the number of inputs (i.e. 223 ± 13.1 nl/min)*

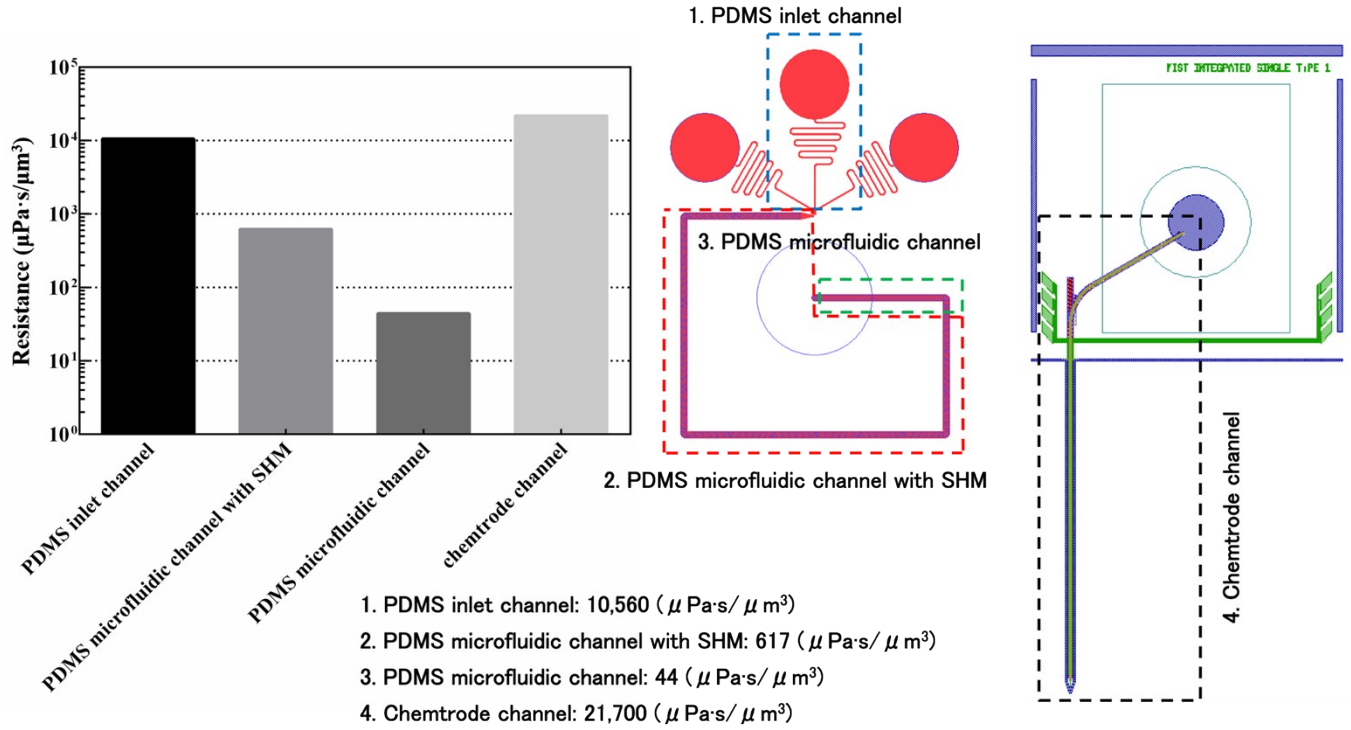

Fig. S2. Estimated resistances across different microfluidic pathways in our system as a solution enters into the PDMS microfluidic channels and the microfluidic channel in our chemtrode. Please note the logarithmic scale.

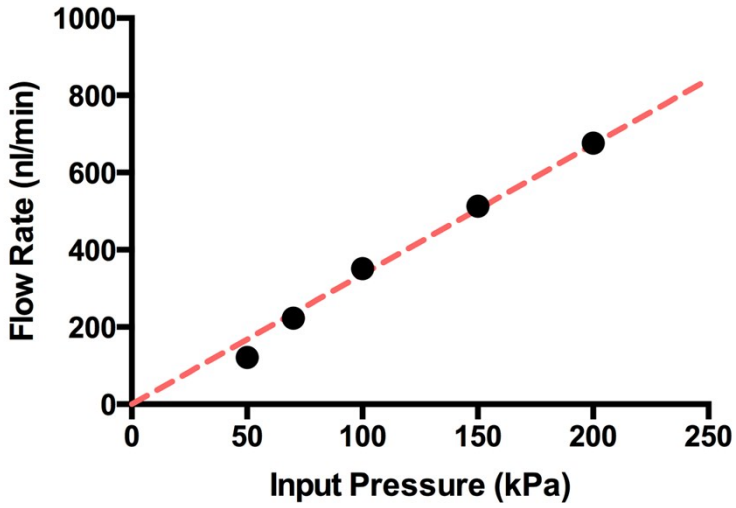

Fig. S3. Measured flow rates of 3-inlet SHM at different applied input pressures with a linear regression shown in red. The same pressure was applied at two inlets while a smaller pressure was applied at the third inlet to prevent backflow.

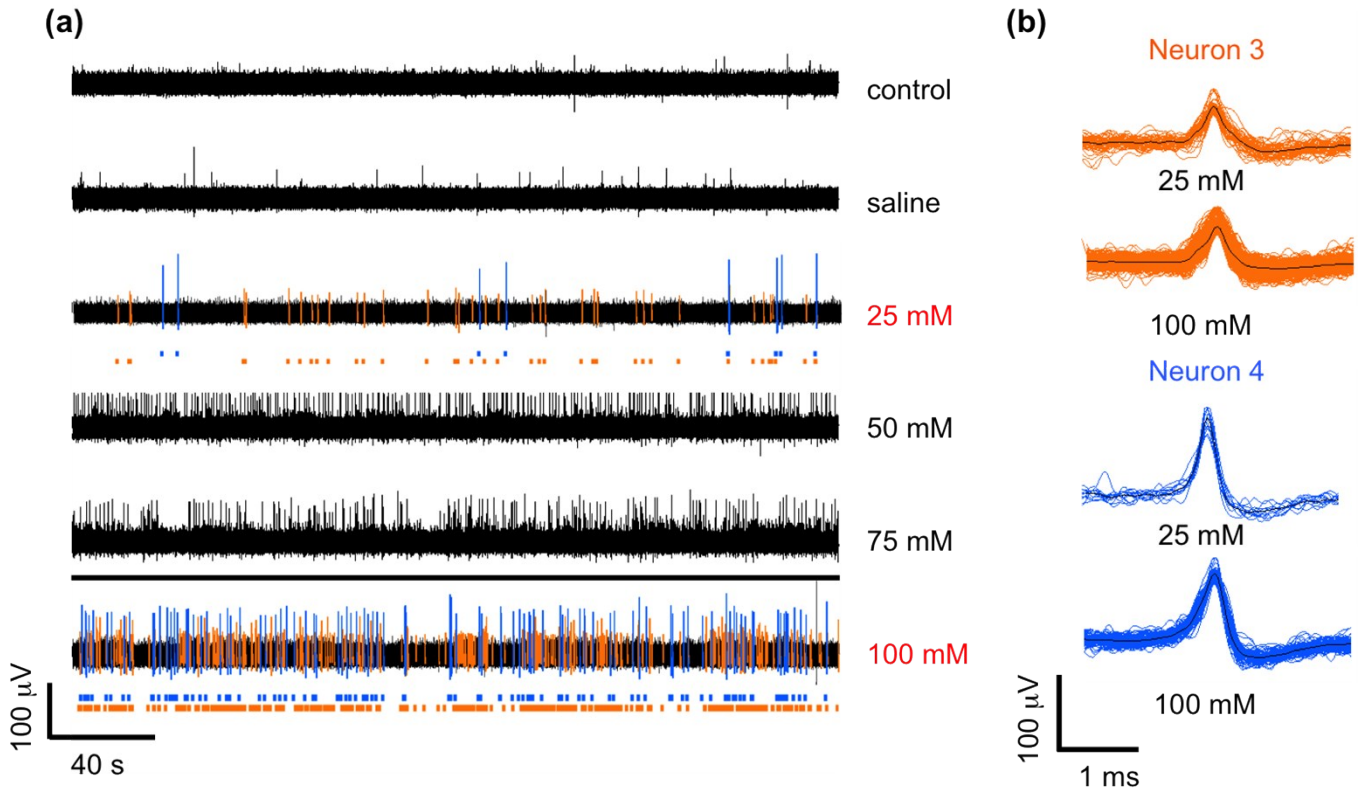

Fig. S4. ***In vivo*** **recording results from direct injection of pilocarpine. (a) Transient plots of individual neural spikes from Ch 2 over 1 min at different concentrations. 'Before' indicates the state when no solution was infused. Raster plots for 25 and 100 mM are shown below the transient plots. (b) Two sorted neural signals at 25 and 100 mM are shown at a smaller time scale.**

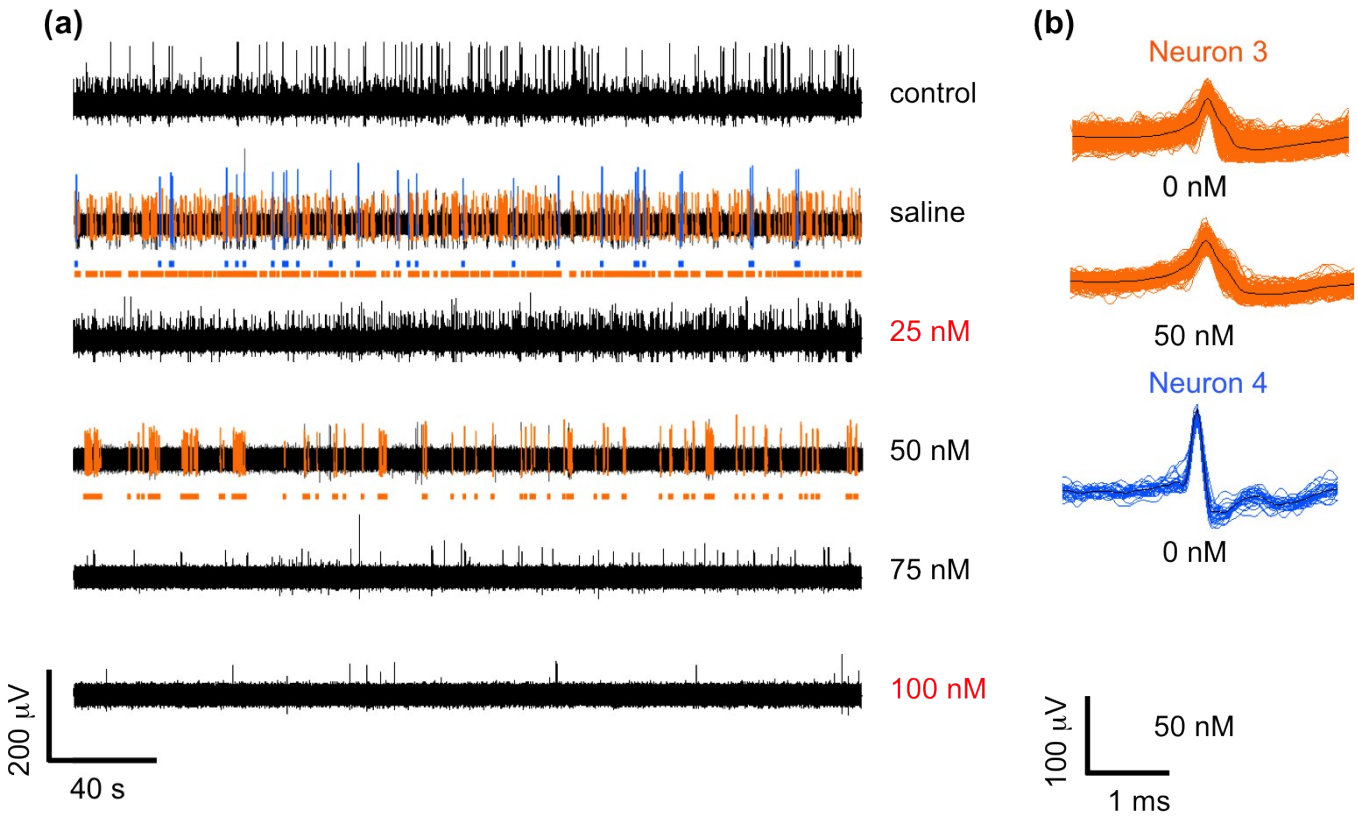

Fig. S5. ***In vivo*** **recording results from direct injection of TTX. (a) Transient plots of individual neural spikes from Ch 10 over 1 min at different concentrations. 'Before' indicates the state when no solution was infused. Raster plots for 0 and 50 mM are shown below the transient plots. (b) Two sorted neural signals at 0 and 50 nM are shown at a smaller time scale.**