

*See attached MP4 files.*

**Extended Data Video 1.** Comparison of full-band (unfiltered) versus 0.5 Hz high-pass filtered fluorescence dynamics during CSD. See corresponding still frames and time series in Figure 1. Time series represent data from an ROI pixel shown as a + on brain maps. Yellow shading indicates stimulation period, grey shading represents seizure persisting beyond the stimulation period. See methods text for pixel-wise seizure detection.

**Extended Data Video 2.** Comparison of neuronal fluorescence dynamics (top left) and hemodynamics (top right) from stimulation eliciting bilateral CSD. Same data as Extended Data Video 1. Time series represent data from ROI pixels shown as + and o on brain maps above.

**Extended Data Video 3.** Comparison of neuronal fluorescence dynamics (top left) and hemodynamics (top right) from stimulation eliciting unilateral CSD. Time series represent data from ROI pixels shown as + and o on brain maps above. Note high frequency stimulation (100 Hz) sometimes elicited a seizure so brief, it consisted of a single ictal discharge during the stimulation period, without persistent seizure after stimulation.

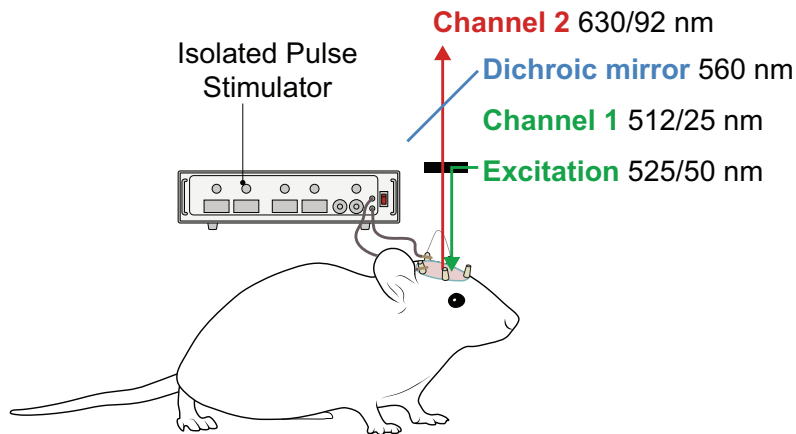
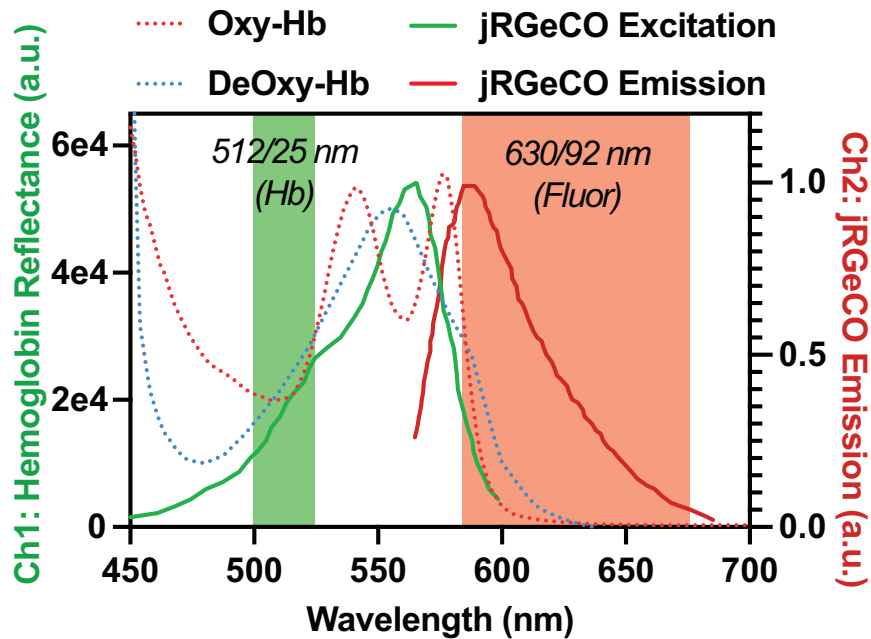
**Extended Data Video 4.** Comparison of neuronal fluorescence dynamics (top left) and hemodynamics (top right) from stimulation eliciting seizure alone, without CSD. Time series represent data from ROI pixels shown as + and o on brain maps above. Note total hemoglobin concentration returns to baseline within ~20 seconds after seizure alone in the absence of CSD.

Mouse Number	Electrodes	Frequency (Hz)	Current step at CSD (mA)	Train Duration (s)	Pulse Count
2	1,4	5	10	10	50
3	4,5	5	10	10	50
4	1,4	5	25	5	25
4	1,3	5	25	10	50
5	3,4	5	5	10	50
6	1,5	5	10	10	50
8	3,5	5	25	10	50
9	4,5	5	25	5	25
9	1,5	5	25	10	50
5	4,5	10	25	2.5	25
7	4,5	10	25	5	50
8	1,4	10	10	2.5	25
10	1,4	10	25	5	50
1	4,5	25	25	2	50
6	4,5	25	25	1	25
6	1,4	25	25	2	50
4	4,5	50	10	1	50
7	1,4	50	10	0.5	25
9	1,4	50	5	1	50
10	4,5	50	25	0.5	25
1	2,3	100	5	1	100
1	1,4	100	10	0.25	25
2	1,3	100	5	1	100
3	1,4	100	5	1	100
4	1,5	100	5	1	100
4	2,4	100	10	0.5	50
5	1,4	100	5	0.5	50
5	1,2	100	5	1	100
5	1,5	100	10	0.5	50
6	2,5	100	5	1	100
7	2,4	100	5	1	100
8	3,5	100	5	1	100
8	1,2	100	5	0.5	50
8	4,5	100	10	0.5	50
9	1,3	100	5	0.5	50
9	4,5	100	10	1	100
10	3,5	100	5	0.5	50
10	3,4	100	5	1	100

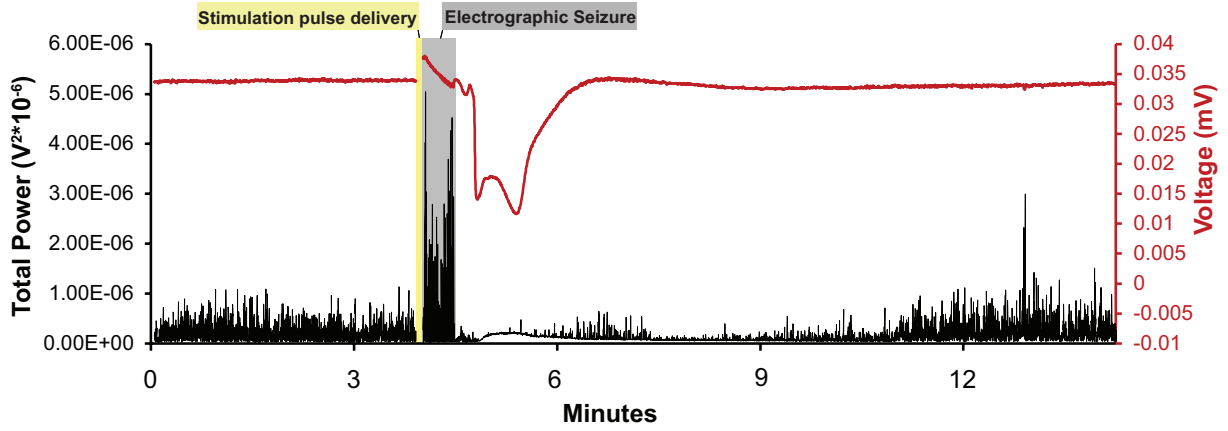
**Extended Data Table 1.** Stimulation parameters for Mouse ECT titration recordings.

Patient	Stimulation	DOS Signal Quality	DCS Signal Quality	CSD?	QC notes	Treatment Type / #	Pulse Width (ms)	Frequency (Hz)	Pulse train duration (s)	Current (mA)	Impedance (Ohms)	Energy (J)	Motor seizure (s)	EEG/Central Seizure (s)	
1	BT	poor	poor		Poor sensor contact with skin	Index	3	0.5	50	6	800	154	28.9	34	37
1	BT	poor	poor		Poor sensor contact with skin	Index	4	0.5	80	6	800	154	45.7	28	32
2	RUL	good	poor	right	DCS censored for beta fluctuation	Index	4	0.37	120	8	800	184	82.8	17	41
2	RUL	poor	poor		Poor signal - beta fluctuation	Index	5	0.37	120	8	800	177	80.9	11	41
3	BT	N/A	N/A		File saving error	Maintenance	19	0.5	90	8	800	132	61.3	41	61
4	BF	poor	poor		Midline placement with BF electrodes	Maintenance	29	0.5	120	6	800	167	77.4	54	79
4	BT	poor	poor		DCS censored for beta fluctuation	Maintenance	38	0.5	120	6	800	134	61.9	55	73
6	BT	good	good	bilateral		Maintenance	33	0.5	90	8	800	192	88.1	43	68
8	RUL	good (R side)	good (R side)	right (no	L sensor placed on back of head, too	Maintenance	18	0.37	120	8	800	197	89.4	46	60
9	RUL	poor	poor		Incompatible skull anatomy, low photon	Index	5	0.37	120	8	800	162	58.4	22	76
9	RUL	poor	poor		Incompatible skull anatomy, low photon	Index	6	0.37	120	8	800	147	65.6	35	62
9	RUL	poor	poor		Incompatible skull anatomy, low photon	Index	7	0.37	120	8	800	176	78.7	28	51
11	BT	good	good	right ( L		Maintenance	38	0.5	120	6	800	203	92	46	69
12	BT	good	poor	no	DCS censored for beta fluctuation	Maintenance	10	0.5	90	8	800	125	58	40	65
12	BT	poor	poor		DCS censored for beta fluctuation	Maintenance	11	0.5	90	8	800	151	70.7	37	79
13	RUL	poor	poor		Confounding motion artifact from	Index	1	0.37	30	2	800	240	5.2	3	5
13	RUL	good	good	right		Index	2	0.37	60	6	800	218	28.9	36	59
13	RUL	good	good	right		Index	3	0.37	120	8	800	240	107.4	29	60
13	RUL	good	good	right		Index	4	0.37	120	8	800	230	101.8	35	54
13	RUL	good	good	bilateral		Index	5	0.37	120	8	800	225	101	12	36
14	BT	good	good	bilateral		Maintenance	57	0.5	80	5	800	176	45.1	84	104
15	RUL	good	good	bilateral		Maintenance	9	0.37	120	8	800	237	105.7	44	57
16	RUL	poor	poor		DCS censored for beta fluctuation	Index	1	0.3	30	2	800	215	4.8	64	137
16	RUL	poor	poor		Poor signal - beta fluctuation	Index	2	0.3	50	5	800	187	17.1	81	105
16	RUL	poor	poor		Poor signal - beta fluctuation	Index	3	0.3	60	6	800	191	25.7	49	85
17	BT	good	good	bilateral		Maintenance	21	0.5	90	5	800	150	42.7	101	138
18	RUL	poor	poor		Poor signal - beta fluctuation	Maintenance	49	0.37	120	8	800	250	111.7	24	46

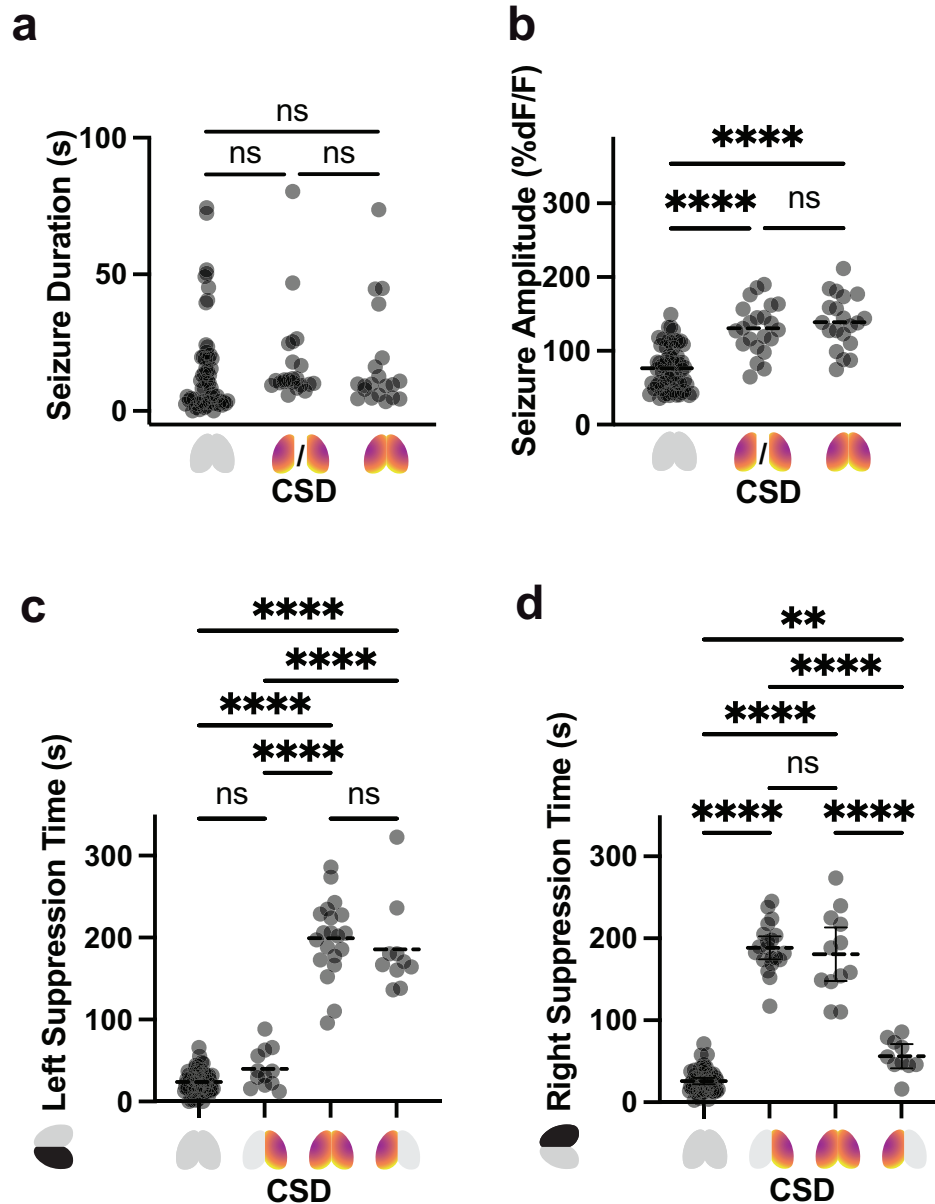
**Extended Data Table 2.** Stimulation parameters for Human ECT recordings.



**Extended Data Figure 1.** Absorption/Reflectance spectra of oxy- and deoxy-hemoglobin, as well as excitation and emission spectra for jRGECO1a fluorescence. Illumination for both hemoglobin and fluorescence signals is provided at 525/50nm; light reflected and emitted by the brain is then directed through a dichroic and image splitting optics to isolate channel 1, green 512/25nm reflectance at the isosbestic point of oxy- and deoxy-hemoglobin (total blood volume/hemoglobin independent of oxygen saturation), and channel 2, red 630/92 nm fluorescence from jRGECO.



**Extended Data Figure 2.** Mouse Electrocortigraphy during ECT-induced seizure and CSD. Black trace corresponds to total power (0 - 500 Hz). Red trace corresponds to 2 Hz low-pass filtered data.



### Extended Data Figure 3 – Summary Metrics of All Seizure and CSD events

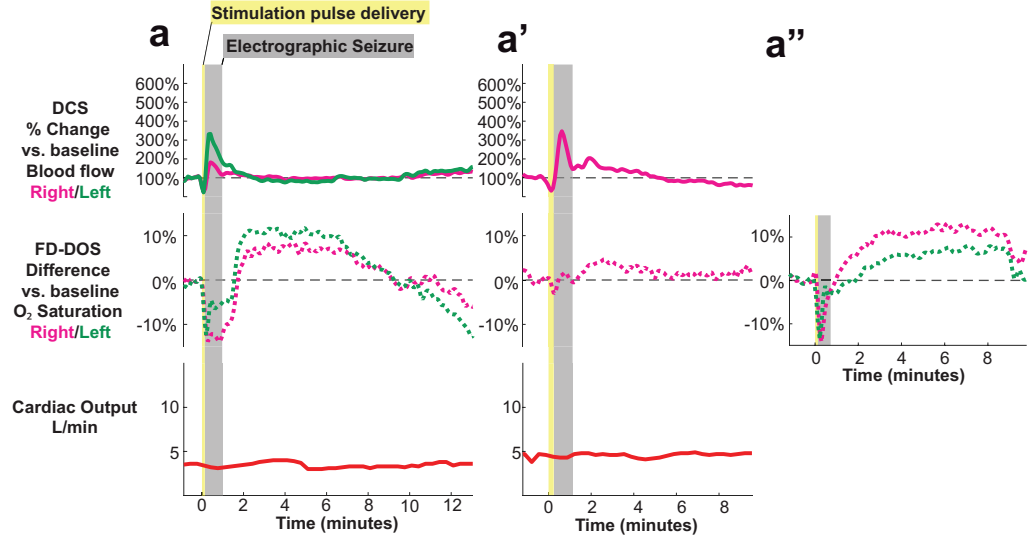
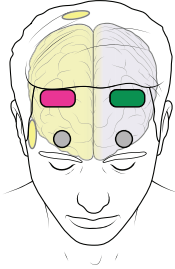
**a**, Average peak fluorescence of seizures that were followed by no CSD, unilateral CSD (pooled right and left), or bilateral CSD. Statistical analysis by Kruskal-Wallis test for non-Gaussian data distribution with Dunn's multiple comparison correction.

**b**, Average duration of seizures that were followed by no CSD, unilateral CSD, or bilateral CSD. Same statistical approach as a. ( $p^{****} < 0.0001$ ,  $\alpha = 0.05$ ).

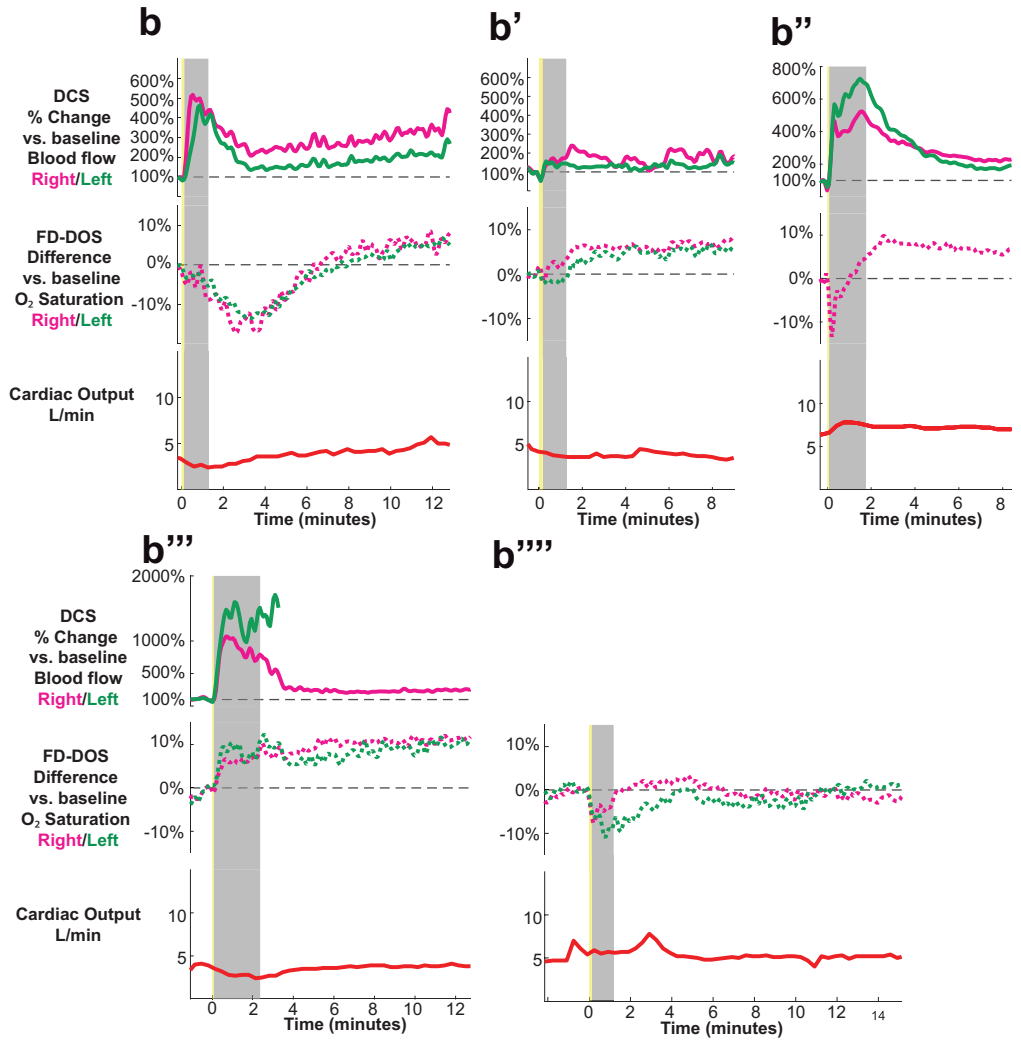
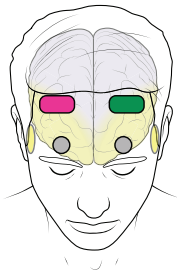
**c**, Left hemisphere post-event suppression time (time to return of baseline 1-3 Hz slow wave power) after seizure alone (no CSD), right unilateral CSD, left unilateral CSD, or bilateral CSD. Statistical analysis by Brown-Forsythe test for normally distributed data, with Dunn's multiple comparison correction ( $p^{****} < 0.0001$ ,  $\alpha = 0.05$ ).

**d**, Right hemisphere post-event suppression time (time to return of baseline 1-3 Hz slow wave power) after seizure alone (no CSD), right unilateral CSD, left unilateral CSD, or bilateral CSD. Statistical approach same as c. ( $p^{**} < 0.01$ ,  $p^{****} < 0.0001$ ,  $\alpha = 0.05$ ).

**Right Unilateral Electrodes**



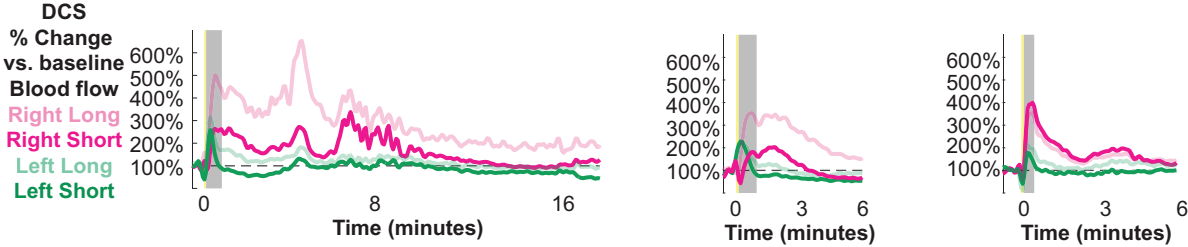
**Bilateral Electrodes**





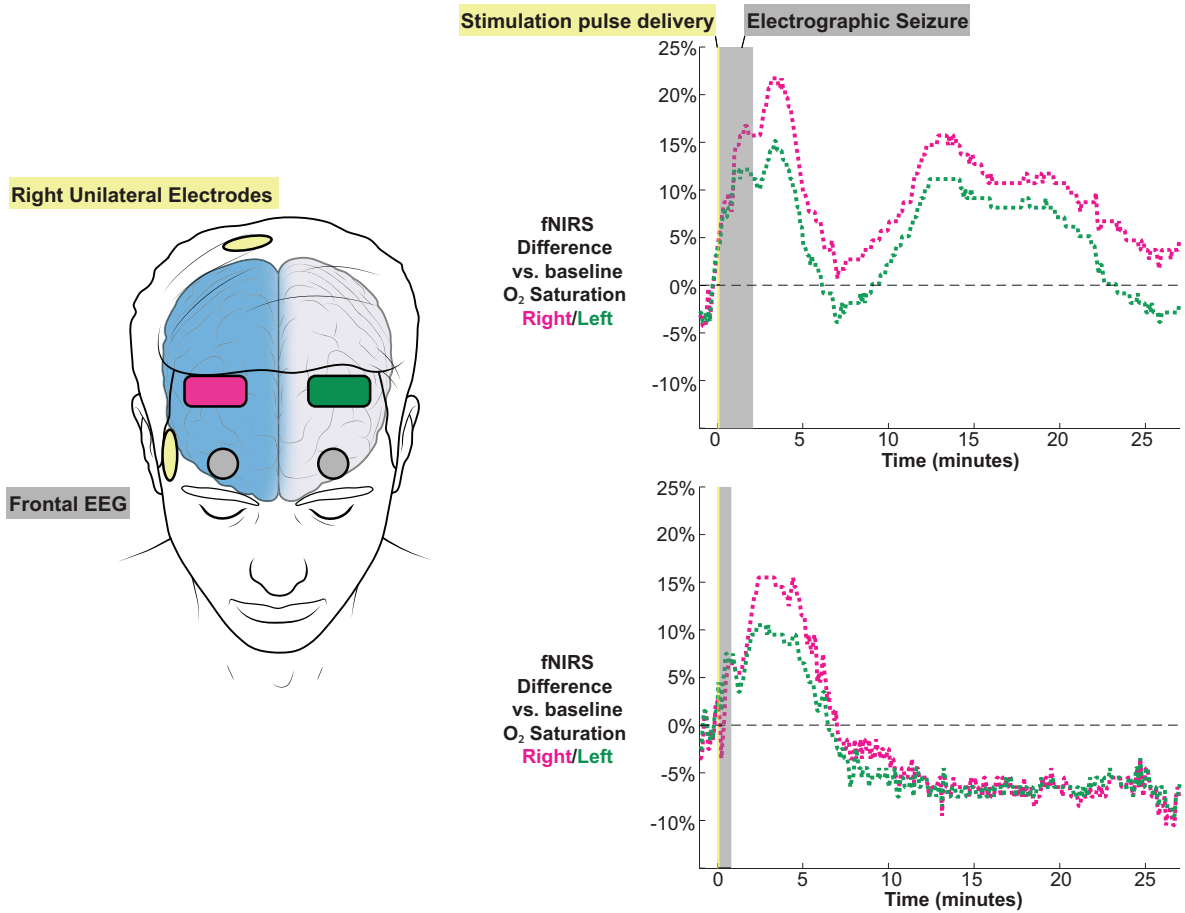
**Extended Data Figure 4. Extended SWEET COMBO Data**, including all additional recordings. See Extended Data methods for data quality control and exclusion criteria.

- a, Three recordings of right unilateral ECT from three separate patients (see Table 2)
- b, Five recordings of bitemporal ECT from five separate patients. In all recordings except for one (b'''), there is clear evidence of post-ictal waves of hyperperfusion evidenced as increased CBF >200% above baseline, or  $\Delta O_2$  % saturation greater than 5%.

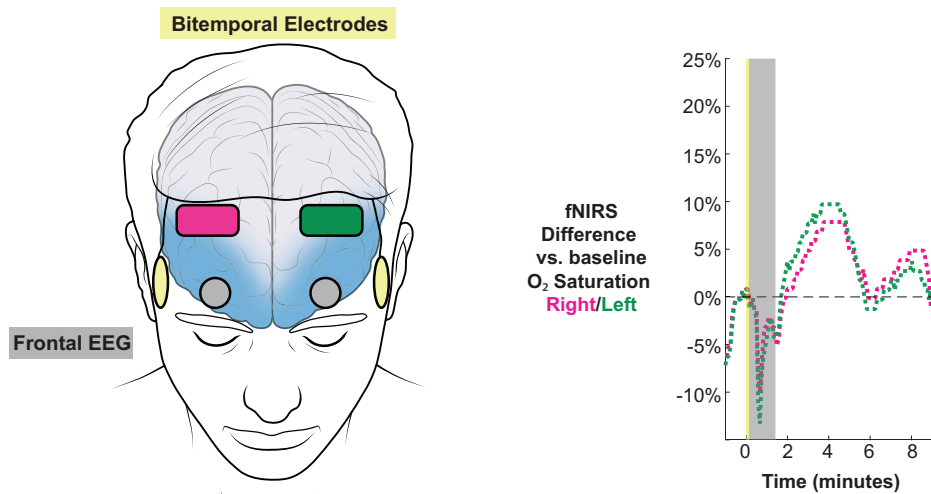


**Extended Data Figure 5.** Right (magenta) and left (green) long source-detector sensor of cerebral blood flow data 4 (transparent lines) overlaid with short source-detector sensor of scalp and skull blood flow (solid lines). Three example recordings presented.

a



b



**Extended Data Figure 6.** Case series of human functional near infrared spectroscopy (fNIRS) recordings of brain oxygen saturation during ECT. Two cases of right unilateral ECT, and one case of bitemporal ECT. Data presented as difference from baseline % saturation. Note secondary post-ictal waves of >5% increase from baseline cerebral oxygenation.