Movies of rhythmic activity '*in vivo*', '*in vitro*' and '*in silico*'.

All Movies are presented in GIF format. Due to space limitations, the original recordings were cut to contain only essential representative frames and the Movies were compressed.

Supplementary Movie 1S. Two-photon calcium imaging of the persistent activity in intact preparation containing functional respiratory network.

A sample trial of time-lapse two-photon fluo-3 imaging taken at low magnification (x10). Acquisition time, 1 s, image size = 300 x 300 μm. In this Movie and in Movies 2S – 4S, the original frames were background-subtracted, 3 x 3 median filtered and divided by the reference image. The latter was generated from minimal pixels in a whole stack and corresponded to the 'resting fluorescence' F_o. Note that synchronous activity is not uniform in the whole slice and it is generated in 'hot spots' which represented the clusters where neurons discharged almost simultaneously.

Supplementary Movie 2S. Synchronous activity in neuronal clusters and its modulation by thapsigargin in the functional slice preparation.

Image size = 80 x 80 μm. Time resolution, 0.5 s per frame. First 20 frames show one period of spontaneous activity after which 1 μM thapsigargin was applied as indicated by the arrow appearing at the image bottom. Note initial potentiation of activity and subsequent suppression. Time-course of calcium changes is presented in the first panel of Fig. 4b.

Supplementary Movie 3S. Time-lapse recordings of calcium transients in culture.

Image size = 160 x 160 μm. Time resolution, 0.3 s per frame.

Supplementary Movie 4S. Generation and propagation of calcium waves in the functional slice preparation.

A sample trial taken in the inspiratory neuron at high magnification (x63) was overlaid on the DIC-image (green). Image size = 120 x 50 μm. Acquisition time, 0.3 s.

Supplementary Movies 5S and 6S. Modelling synchronous activity in clusters of neurons.

Simulations were made as described in Methods. It was assumed that 'excitability' sites are capable to generate calcium transients and to exchange them with intermittent neurons as described in Methods. Calcium levels in 'dendrites' are coded green and the membrane potential of neurons is coded red such as simultaneous excitation appears yellow. The two representative cases are shown respectively in (**5S**) and (**6S**) and correspond to different delays (0.7 and 2.8 s) in propagation of the calcium waves to adjacent sites. The time-dependent changes are shown also in Fig. 6a in main text in the upper and lower traces and correspond to the low- and high-frequency activities. Note that in Movie **5S**, the neurons synchronized their activity and fired simultaneously and in Movie **6S** they discharge in a sequence.