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Neuronal activation in organotypic hippocampal slice culture grown on photoactive material

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Background/Aims: Regenerative processes in neurons following injuries can be improved through electrical stimulation. Wireless, lightweight, organic photocapacitors (photocaps) pose an attractive alternative to standard stimulation procedures. Upon illumination, they charge within microseconds, creating electric field, which can activate excitable cells in their vicinity. In this study, we aimed to elicit molecular changes in cultivated hippocampal slices by means of photocapacitive stimulation. Methods/Results: Postnatal rat hippocampal slices were cultured on photocaps for 5 days. Then, the culture was exposed to red light pulses for 30 minutes with an LED red light source (3 W). Neuronal activation was assessed by c-fos immunoreactivity with fluorescent staining of paraffin-embedded serial transversal cuts of the slices. Double and triple immunostaining was performed to mark different brain cell populations. Light-stimulated slices showed increased cellular expression of c-fos protein compared to the controls without light treatment. Multiple immunostaining of c-fos with marker for neuronal nuclei revealed a predominantly neuronal expression of the protein. Cell activation was observed throughout the entire transversal cut of the slices. Conclusion: Single light treatment of organotypic hippocampal slice culture on organic photocaps resulted in an increased neuronal expression of c-fos as compared to the non-treated group, indicating photocapacitive stimulation leads to activation and molecular changes in excitable cells ex vivo. The appearance of c-fos signal in top layers of the cultivated slices implies bottom-up signal propagation from neurons located in the close contact with the device, meaning activation of wide neuronal networks.