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Real-time detection of quantal dopamine release from single cells stimulated by X-ray irradiation

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Ionizing radiation is an effective tool employed in cancer therapy and recent technological developments have led radiotherapy to a high level of accuracy. Beyond targeted effects, many studies have also highlighted the importance of off-target consequences of ionizing radiation, such as the bystander and abscopal effects [1]. Several mechanisms have been identified for the propagation of radiation effects out of the irradiated region [2-3]. However, a complete understanding of the mechanisms underlying both effects is still missing and no real-time data about signals released by cells during irradiation are presently available. Here we show the real-time simultaneous measurement of both incoming X-rays and neurotransmitter release in vitro from individual adrenal phaeochromocytoma (PC12) cells plated over a diamond based multi-electrode array and exposed to a synchrotron X ray nano-beam. Beyond identifying the critical doses corresponding to instantaneous death of individual cells, we have shown that, in specific conditions, X-rays are able to alter PC12 cell activity by promoting dopamine exocytosis, which so far was not considered as associated to X-ray irradiation [4]. Since dopamine affects tumour growth by inhibiting angiogenesis but cannot be injected at the systemic level because of its toxicity [5], further studies about the possibility to locally stimulate dopaminergic cells via X-ray irradiation should be considered as potentially attractive for a better treatment of tumours.

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