“Bystander effect”

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Key points

- Concept
- Historical evolution
- Paradigm change
- Mechanisms
- Its implications in radiological protection
- Its implications in radiotherapy
- Conclusions

Concept

- Biological effect based on the transmission of information from radiated cells to cells that haven´t been radiated and which are out of the radiation area but close to the cells which have been radiated[1].

- Using different mechanisms, the radiated cells transmit the biological effect caused by the radiation, to nearby cells, causing them the same effect, which consists of DNA damage.

- This effect can be transmitted to descendant cells; this would cause damage at an even higher scale.

- We go from talking about cellular damage to tissue damage.

Historical evolution

1953	Mole	Abscopal effects (in the field of radiotherapy)
1970	Immunologyl and gene therapy	“Bystander” term was defined
1992	Nagasawa and Little	Vecinity effects and ionising radiation (demonstrated *in vitro* and *in vivo*)

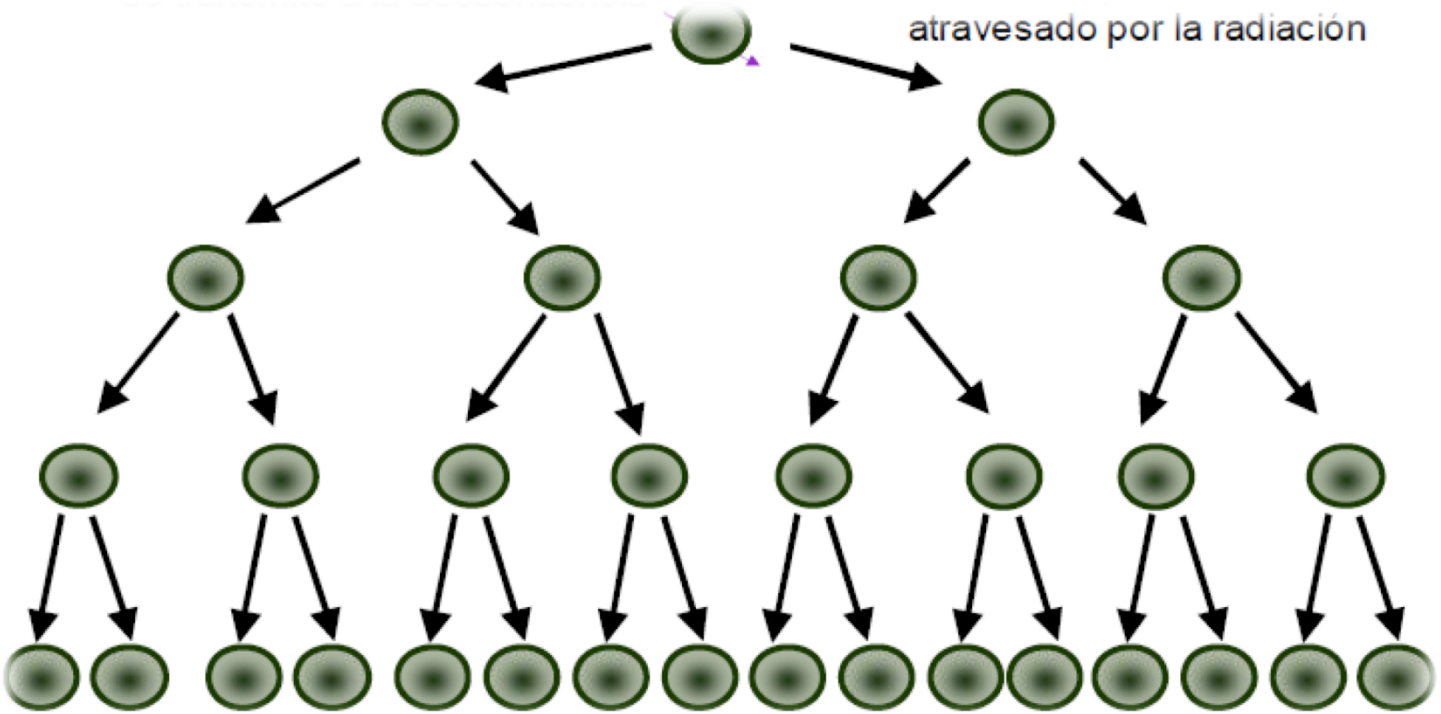
The development of technology and, in particular, the development of microbeams of radiation, permitted scientists to prove the existence of the “bystander” effect, both *in vitro* and *in vivo*[2].

Paradigm change

Past beliefs:

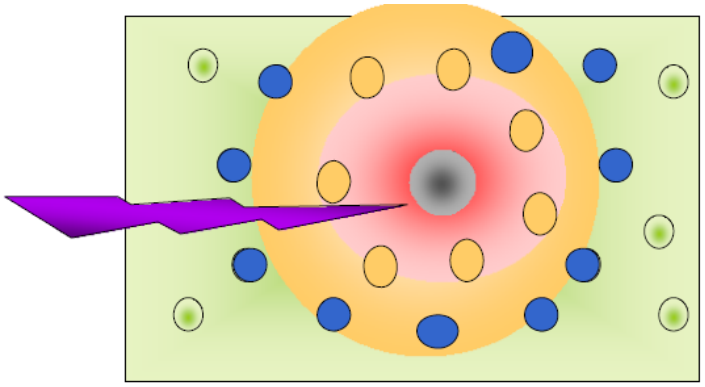
- The DNA damage caused by the radiation, is transmitted to descendant cells.

- This damage is only caused on cells that have been directly reached by the radiation



Paradigm change

The proof of the existence of the “bystander” effect caused by radiation has generated a big change in the field of radiobiology[3].



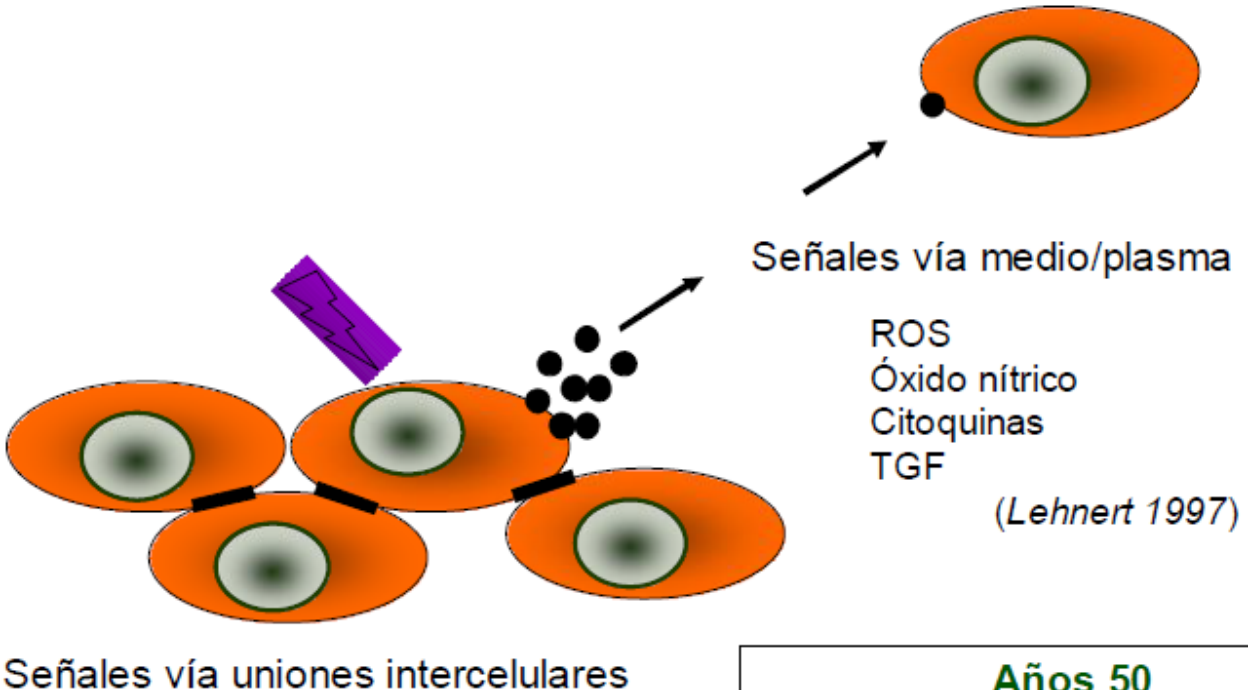
The new paradigm includes two new aspects:

- When a cell is damaged by radiation, this cell can transmit the effect to cells that surround it.

- This transmission can alter the nearby cell`s function or it can stimulate them to respond and transmit the effect to even more cells.

Mechanisms

- The existence of the “bystander” effect means that there must be mechanisms through which the effect is transmitted. These mechanisms are:
  1. Cellular junctions
  2. Extracellular signs



Its implications in radiological protection

- The “bystander” effect amplifies the biological efficiency of a dose of radiation.

- Many of the indirect effects described earlier indicate that the harmful effects caused by radiation affect a bigger area than the area that has been radiated. This should be taken into account, when the population´s health is involved[4].

Its implications in radiotherapy

- In radiotherapy, when multiple areas of radiation are used, the dosage of radiation used has to be thought out very carefully, because the “bystander” effect has introduced certain doubts about the maximum dosage used, especially on the outer parts of the radiation area.
- It would be useful if we reconsidered what we understand by “area of radiation” and we should try to introduce a “biological penumbra” as well as a “physical penumbra” when we use radiotherapy.

Conclusions

- The exposure of cells to radiation can cause changes in nearby cells that haven´t been reached by this radiation.
- These changes are caused because there is communication between cells. This communication can be held by direct contact or via liberated mollecules.
- The existence of these effects prove that radio-induced cancer is not only a cellular event, it is also a tissue event.
- The discovery of the “bystander” effect has contributed to the change of the radiobiology paradigm and it has also proven to have implications in radiological protection and radiotherapy.

Bibliographic references

[1] Página web: www.quimicanuclear.org/pdf_memorias2004/SIMPOSIO/JOSE%20TRINIDAD/SQMERIDA01JOSE.pdf : artículo: Panorama actual de la dosimetría de radiaciones ionizantes. J.T. Alvarez-Romero

[2] Página web: http://rmu.fcm.uncu.edu.ar/vol05_04/articulos_de_revision/index.php : artículo: Efectos de vecindad de la radiación ionizante y sus implicaciones en radioterapia y radioprotección. Prof. D. Fernando D. Saraví

[3] Página web: http://rmu.fcm.uncu.edu.ar/vol05_04/articulos_de_revision/index.php : artículo: Efectos de vecindad de la radiación ionizante y sus implicaciones en radioterapia y radioprotección. Prof. D. Fernando D. Saraví

[4] Página web: http://www.sepr.es/html/recursos/descargables/RB2012_TEMA%2011_A%20Real.pdf Efectos no convencionales de las radiaciones ionizantes. Almudena Real

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