HYDROGELS WITH RESPONSIVE MESOPOROUS SILICA NANOPARTICLES FOR LOCAL SUSTAINED DRUG DELIVERY

DESCRIPTION OF INVENTION

Limited penetration of the blood brain barrier of systemically administered anticancer drugs is one of the causes of the unsuccessful of current therapies. For this reason, local drug administration is considered as one of the options to counteract these disadvantages. A major challenge in local drug delivery is associated on the one hand with achieving greater availability and penetrability of the drug in the tumor or cells near it once removed and on the other hand to achieve a sustained and selective drug delivery only at the therapeutic target. Therefore, it is necessary to develop new materials for local administration of drugs that increase their availability in the tumor and ensure a controlled and sustained release at the site of action. In the face of this need, the present invention proposes a new material for local administration of drugs composed of an injectable hydrogel of in situ formation that includes drugs encapsulated into mesoporous silica nanoparticles with molecular gates.

The present invention describes a new material for local sustained and selective drug delivery composed by: (i) a hydrogel of in situ formation which could consist of hyaluronic acid (HA)-based gels and chitosan/γ-glycerophosphate (GP) gels (ii) mesoporous silica nanoparticles type MCM-41 from 100 nm to 200 nm and a pore diameter between 2 nm and 50 nm. These nanoparticles are embedded into the gel matrix and its pores are capped with molecular gates of type polyethylene glycol (PEG) which modulates the release of the drug into the target cell. Among the drugs that can be encapsulated into the pores of the nanoparticles are Daunorubicin, Camptotecin, fluoruracil, Cisplatin, Carboplatin, Temozolomide, Carmustine, Docetaxel and Doxorubicin (DOX).

The release of the drug occurs in response to a high concentration of glutathione (GSH) present in carcinogenic tumors (Figure 1). This material has a versatile design, that allows the use of any other type of hydrogel of in situ formation and particles with molecular gates that respond to stimuli such as pH, temperature, enzymes, among others.

BUSINESS APPLICATIONS

- The new material developed could be used to treat diseases such as cancer in two main applications: its implantation into the tumor environment with the aim of reducing injury in hard-to-reach places, or after surgical resection of the tumor to prevent metastasis or recurrence.
- Local administration of drugs in any area of the body where a sustained release of drugs is needed.

TECHNICAL ADVANTAGES AND BUSINESS BENEFITS

- New biocompatible material that allows the local delivery of drugs in a sustained manner and only in the target site.
- Local application material in liquid form capable of gelling at the site of tumor removal or other body site where it is of interest the local and sustained delivery of drugs.
- The on-site formation of the hydrogel when administered in liquid form allows to acquire the same form of the cavity of the removal and increase the availability and penetration of the nanoparticles containing the medicine.
- The molecular gates that capped the nanoparticles of the proposed material allows the sustained release of the drug, in the target area, avoiding premature release in areas where it is not necessary.
- Material with a versatile design, which can be applied in different areas of the body using a variety of in situ formation hydrogels and nanoparticles with molecular gates giving place the release of the drug in the presence of specific stimuli such as pH, enzymes, etc.

STATE OF TECHNOLOGY DEVELOPMENT

The material developed has been validated at laboratory level where has been confirmed:

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(i) the in situ formation of the hydrogel when it reaches body temperature or by the presence of crosslinking agents, (ii) the hydrogel does not affect the operation of the molecular gate by observing a significant controlled release of the drug doxorubicin in the presence of glutathione (iii) the biocompatibility of the material through cell viability studies, (iv) the cytotoxic effect of the material over time, by sustained release of doxorubicin into cell cultures. TRL: 3-4

INDUSTRIAL PROPERTY RIGHTS

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Cristina Alemany Làzaro
I2T - Promotion and Support Service for Research, Innovation and Transfer
Universitat Politècnica de València
E: calemany@i2t.upv.es
T: +34 963 877 957
W: innovacion.upv.es/i2t