Review Article

Solid Lipid Nanoparticles: Investigation in Cancer Cell Lines – A Review

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Abstract

Solid lipid nanoparticles (SLN) technology has been rapidly developed in the field of cancer research. Solid lipid nanoparticles (SLNs) technology represents a promising approach to cancer drug delivery system. Unique size of the lipid nanoparticles offer to develop new therapeutics or drug delivery system for cancer. The solid lipid nanoparticles showed promising approaches for controlled and site specific cancer drug delivery. Therefore, the present review described about achievements of solid lipid nanoparticles in the field of cancer biology.

Introduction

Nanoparticle Drug delivery systems have been used as a promising approach to alter and improve the pharmacokinetic properties of various types of drug molecules including cancer drugs. Solid Lipid Nanoparticles (SLN) technology is the alternative drug carrier systems to improve the bioavailability of the drugs [1]. SLN is mainly composed of solid lipids and this lipid matrix became extremely popular in controlling release of drugs including anti-cancer drugs. Benefits of the SLN technology are; administration of drugs via oral, topical and i.v. routes are possible and industrial applicability for increasing the bioavailability. SLN drug delivery systems have been developed to rectify following problems; a) poor drug solubility and drug distribution in the tissues. Some drug delivery system like liposomes, nanoemulsions and nanocapsules has been developed [2]. But still solid lipid nanoparticle (SLN) drug delivery system has fascinated more attention in the field of cancer biology to deliver the anti-cancer drugs in the targeted organs or tissues. Therefore, the present review described about achievements of solid lipid nanoparticles in the field of cancer biology.

SLNs on HT-29 cell line

HT-29 cell line was obtained from a colon adenocarcinoma. This cell line is widely used to study anticancer activity against colon cancer in an in vitro model. Antiproliferative effect of solid lipid nanoparticles (SLN) carrying cholesteryl butyrate (chole-but), doxorubicin and paclitaxel was investigated on HT-29 colorectal cancer cell lines. The results indicated that combination of low concentrations of chol-but SLN and doxorubicin or paclitaxel showed a potential antiproliferative effect against HT-29 cells [3]. 5-fluorouracil (5-FU) loaded-solid lipid nanoparticles (SLNs) were prepared and investigated its anticancer activity against colon cancer. SLNs were prepared by double emulsion-solvent evaporation technique. The results indicated that The SLNs system showing high potential to progress the uptake of anticancer drugs inside colon tumors. The release profile of 5-fluorouracil (5-FU) loaded-solid lipid nanoparticles (SLNs) in simulated colonic medium showed a prolonged release pattern. This prolonged release pattern might be due to spreading of the 5-FU-SLNs inside the colon where the tumors may present [4].

SLNs on brain endothelial cell line

Brain cancer can be studied using brain endothelial cells. Docetaxel is used in the treatment of brain cancer. Entries of docetaxel into the brain cells are limited due to p-glycoprotein efflux. Ketoconazole inhibited p-glycoprotein efflux of docetaxel at blood brain barrier. Docetaxel – ketoconazole with surface-modified dual drug-loaded SLNPs were prepared and investigated its effects on brain endothelial cells. Brain pharmacokinetics parameters showed increasing brain uptake of docetaxel with surface-modified dual drug-loaded SLNPs. This results indicated that docetaxel with surface-modified drug-loaded SLNPs were appropriate for the delivery of anticancer drugs to the brain.
SLNs on MCF-7/ADR cell line
MCF-7/ADR cells are widely used as a breast cancer cell model in cancer research. Doxorubicin loaded solid lipid nanoparticles (SLN-Dox) were studied in MCF-7/ADR cells cell lines. (SLN-Dox) nanoparticles did not exhibit hemolytic activity. (SLN-Dox) nanoparticles efficiently improved apoptotic cell death through higher accumulation of doxorubicin in breast cancer cells. This study suggested that (SLN-Dox) nanoparticles approach might be useful for the treatment of breast cancer [6].

SLNs on MXT-B2 cell line
MXT-B2 cells, a metastatic mammary carcinoma cell line and can be used to study lung metastases. Lung cancer remains a primary cause of death due to the low effectiveness of chemotherapy. Paclitaxel (PTX) is an insoluble anticancer drug active against lung cancer. Pulmonary delivery of paclitaxel (PTX) loaded-solid lipid nanoparticles (SLNs) was investigated in MXT-B2 cell line (murine mammary adenocarcinoma-MXT) suspension. This study suggested that SLN-PTX potentially suppressed lung metastases and paclitaxel-loaded lipid nanocarrier could be useful for treatment of lung cancer [7].

SLNs on MCF-7, PC-3, and SK-N-SH cell line
MCF-7 [Michigan Cancer Foundation-7, Breast cancer cell line], PC-3 (prostatic carcinoma cell line) and SK-N-SH (human neuroblastoma) cell lines are used to study about anticancer activity against Breast, prostate and neuroblastoma cancers. 2-methoxyestradiol (2-ME)-loaded solid lipid nanoparticles (SLN) were prepared by hot homogenization-ultrasonication and anti-cancer effect was observed against three cell lines, breast cancer (Michigan Cancer Foundation-7 (MCF-7)), prostatic carcinoma (PC-3), and glioma (SK-N-SH). The results indicated that 2-ME SLN showed more effective on PC-3 cells and SK-N-SH cells, whereas a low effect was observed on MCF-7 cells. This study suggested that SLN could be an appropriate carrier to entrap 2-ME for improving cancer chemotherapy [8].

SLNs on P388/ADR leukemia cell line
P388/ADR cell line was derived from the P388 murine leukemia and used in cancer research. Solid lipid nanoparticles (SLNs) of idarubicin (IDA) and doxorubicin (DOX) against Pgp-mediated multiple drug resistance (MDR) in-vitro and in-vivo using different human and murine cancer cell models was investigated. The results indicated that DOX solid lipid nanoparticles could beat Pgp-mediated MDR both in-vitro in P388/ADR leukemia cells and in-vivo in the murine leukemia mouse model. This study indicated that SLNs could offer potential anticancer drug delivery drugs for the treatment of Pgp-mediated MDR in leukemia [9].

SLNs on Calu-3 cell line
Calu-3 cell line is a human lung epithelial cell line and used in an in vitro models for cancer studies. Phenethyl Isothiocyanate (PEITC)-loaded chitosan-solid lipid nanoparticles was investigated in Calu-3 cells in the presence or absence of the efflux-transporter inhibitors. The results indicated that efflux transporter inhibitors influenced the PEITC uptake rate by Calu-3 cells. This study expressed that chitosan-solid lipid nanoparticles could be an efficient drug delivery system for the substrates susceptible to the efflux-transporters [10].

SLNs on Ehrlich Ascite Carcinoma (EAC) cells
Ehrlich ascites carcinoma (EAC) cells are used to study the anticancer activity in an in vivo animal model. Formulation, characterization and anticancer activity of methotrexate (MTX) loaded-solid lipid nanoparticles for intravenous administration were investigated against Ehrlich Ascite Carcinoma (EAC) bearing mice model. These results suggested that life span of EAC bearing mice was improved when treated with MTX-SLNs. Moreover, MTX-SLNs showed promising sustained release of antitumour drug targeting system [11].

SLNs on hepatocellular carcinoma cells
BEL7402 cell line is a hepatocellular carcinoma cells and used in cancer research. Docetaxel-loaded hepatoma-targeted solid lipid nanoparticle (tSLN) was formulated and investigated its antitumor efficacy against hepatocellular carcinoma cell line BEL7402. This study suggested that targeted solid lipid nanoparticle of docetaxel could improve the antitumor effect in an in vivo studies and Docetaxel-loaded hepatoma-targeted solid lipid nanoparticle could be useful for the treatment of Human hepatocellular carcinoma [12].

SLNs on MCF-7 breast cancer cell line
MCF-7 is a breast cancer cell line isolated from a 69-year-old Caucasian woman in the year of 1970. This cell line is widely used to study anticancer activity against breast cancer. Therapeutic effect of solid lipid nanoparticles (SLN) of mitoxantrone (MTO) was investigated against Human MCF-7 breast cancer in nude mice and animal model of P388 lymphnode metastases in Kunning mice. This study indicated that MTO-SLNs showed active delivery of antitumor drug against breast cancer cells and its lymph node metastases with excellent therapeutic effect [13].

Conclusion
Due to the some drawback of the other colloidal carriers such as liposomes, emulsions, and polymeric microparticles, solid lipid nanoparticles (SLN) have been developed for anti-cancer drugs. The cancer patients are treated with chemotherapy drugs, but these drugs showing...
less anti-cancer activity and more side effects. Even though many potent anti-cancer drugs are available and it can be clinically applicable. But they may have cellular cytotoxicity and side effects. Thus, solid lipid nanoparticles (SLNs) have been developed as an alternative drug carrier system for anticancer drugs without any cytotoxicity and side effects. Benefits of the SLNs are; long time physical stability and controlled drug release of anticancer drugs. Therefore, solid lipid nanoparticles (SLNs) could be a potential carrier to deliver the anti-cancer drugs effectively in the targeted organ or tissues. Moreover, SLNs with anticancer drugs formulation could be appropriate to treat various cancers (lung, breast, colon kidney and hepatoma cancer) in the field of cancer biology.

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References:

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