Journal of Paediatric Medicine & Surgery

Niknejad, J Paediatr Med Sur 2022, 6:6

Review Article Open Access

The Intriguing Near-IR Quantum Dots could be used to Differentiate Stem Cells Using Growth Factors

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Abstract

For somatic cell medical care of chronic diseases, it's necessary to differentiate stem cells into the particular lineage. There are a unit many growth factors that are used for differentiation of stem cells. Some issue protein}s will dose-dependently induce differentiation of stem cells so the rise of growth factor concentration ends up in production of the upper level of differentiated cells. However, because of the toxicity of some differentiation factors (e.g. retinoic acid), the lower dose of growth factors for the particular lineage differentiation of stem cells is fascinating. This paper suggests a brand new approach within the field of controlled protein delivery system victimisation semiconductor nanocrystals; referred to as quantum dots (QDs). This method contains chemical compound microencapsulated protein that is conjugated to close infrared (NIR) interesting QDs [1]. The management unharness of growth factors from microcapsules within the culture plates are often achieved by irradiation. To modulate protein unharness in response to stem cells wants for differentiation, the intensity and amount of irradiation are controlled. Our hypothesis is predicated on the actual fact that QDs will absorb NIR energy and by excitation of electrons so undulation relaxation of them become heated once they were irradiated so unharness growth factors. We have a tendency to believe that controlled growth factors delivery through the instructed system is an efficient technique to scale back the quantity of growth factors needed for differentiation of stem cells.

Keywords: Quantum dots; Nanocrystal; Close to infrared; Stem cells; Differentiation; Growth factors

Introduction

Stem cell medical care may be a new approach to repair pathological tissues or organs. However, to realize therapeutic effectuality, differentiation of stem cells into the particular lineage before transplantation is commonly essential. To differentiate stem cells in vitro, growth factors area unit used. the present common technique for differentiation of stem cells has been supported time ideas wherever the matter is meant to be same associate degreed an enough quantity of growth factors is assumed to be contained within the medium. However, attributable to motion of protein within the medium, solely atiny low quantity reaches the cell receptors associated with biological signal pathways. Therefore, notwithstanding an enormous quantity of protein is intercalary to matter to induce differentiation, solely atiny low fraction would be concerned in differentiation of stem cells. Therefore, the prospect of protein binding to cultivated stem cells ought to be maximized to boost differentiation [2].

Moreover, the utilization of a number of these growth factors presents a big challenge due of their poor water solubility, short half-life and probably virulent effects. RA induces a pan-neuronal differentiation and also the cell population obtained when application of this differentiation issue is comparatively heterogeneous. RA applied to embryonic stem cells (ESCs) will induce concentration-dependent differentiation of neural cells. Tested the results of various concentrations of RA on the neural differentiation of mouse (ESCs). In distinction, high levels of RA ($2 \times 10{-}6$ M) shrunken the expression of nesting whereas increasing beta-tubulin III and GFAP levels. These results area unit per alternative studies demonstrating differentiation of neural progenitors at high RA concentrations. However, RA may be a sturdy agent and may be used at lower doses to forestall toxicity. It's been shown that protein free from a cell culture scaffold might bind to receptors on the classy stem cells far more with efficiency than growth factors intercalary to the matter. Protein delivery employing a cell culture matrix might additionally probably scale back the quantity of protein needed for somatic cell differentiation. Through this approach, it'll be doable to own adequate optimized differentiated cells for somatic cell medical care and regenerative drugs and overcome the matter of donor cell and tissue shortage [3].

Material and Methods

Hypothesis

Conjugations of a protein like RA to an artificial cell culture scaffold offers a localized unharness system for protein. Immobilization of RA to the scaffolds ends up in terribly slow unharnesses. during this study, we have a tendency to hypothecate a system of microencapsulated protein conjugated to close infrared (NIR) interesting quantum dot (QD), within which controlled unharness of growth factors from the chemical compound microcapsules is triggered by NIR irradiation. The energy of NIR radiation is within the undulation levels of atoms and once a QD absorbs NIR, the negatron excited to the higher undulation levels [4]. Then throughout to 10–13 second electrons come to previous undulation level and unharness excess energy within the heat kind. Our hypothesis is predicated on the actual fact that QDs will absorb NIR energy and by excitation of electrons so undulation relaxation of them become heated once they were irradiated so unharness growth factors. this method will outwardly modulate unharness of growth factors like RA and EGF in response to stem cells wants for differentiation by management of the intensity and amount of irradiation. We expect by victimisation this method and dominant of your time and quantity of unharness, the lower levels of growth factors are needed (at physiological

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Received: 03-Dec-2022, Manuscript No: JPMS-22-82840, **Editor assigned:** 05-Dec-2022, Pre QC No: JPMS-22-82840 (PQ), **Reviewed:** 19-Dec-2022, QC No: JPMS-22-82840, **Revised:** 24-Dec-2022, Manuscript No: JPMS-22-82840, **Published:** 29-Dec-2022, DOI: 10.4172/jpms.1000199

Citation: Niknejad H (2022) The Intriguing Near-IR Quantum Dots could be used to Differentiate Stem Cells Using Growth Factors. J Paediatr Med Sur 6: 199.

level) to induce lineage-specific differentiation of stem cells. The property of unharness is reckoning on the kind of differentiation issue, intensity and amount of NIR irradiation and also the alternative parts of scaffold [5].

Evaluation of the hypothesis

To test this hypothesis, NIR-QDs (Cadmium-Selenide); semiconductor nanocrystals with size-dependent absorption and emission, are used. The surface chemistry of QD will regulate the solubility of QD, for instance by addition of a layer of amphiphilic molecules likewise as will functionalize QD. Since RA may be a hydrophobic protein, initially step it'll be needed to treat QD. Then, crosslinking agents like 1-Ethyl-3-(3-dimethylaminopropyl) carbodiimide complex (EDC) and suffocated N-hydroxysuccinimide (sulfo-NHS) are used. So as to conjugate QDs and RA, phenylene organic compound (PDA) is intercalary to the activated QDs and RA resolutions Microencapsulation of QD-RA are performed by double emulsion in solution of PCL and PLGA [6]. When laundry with deionized water, the microcapsules are lyophilised. The morphology of microspheres is examined with scanning microscopy. To avoid accelerator degradation of the scaffold with matrix metalloproteinase secreted by stem cells, it's necessary to use the artificial scaffold. The cell culture plates are coated with PLGA containing QD-RA microspheres. The dynamics of growth factors unharness following irradiation are determined with HPLC. ESCs are cultivated on PLGA scaffold loaded with the definite quantity of QD-RA microspheres. As a sway, stem cells are cultivated with daily addition of a similar amounts of RA to the matter. Somatic cell differentiation is determined victimisation neurite reckoning and Western blot analysis of somatic cell markers expression. To optimize growth factors concentration within the medium at the doable lower level, intensity and amount of NIR irradiation are evaluated as 2 freelance variables. The quantity of warmth are controlled by 2 mentioned variables and temperature of brooder, thus it might not be virulent for the cells and have an effect on the structure of medicine [7].

Discussion

For the past decades, technologies are developed to outwardly trigger the drug unharness per physiological wants. Semiconductor nanocrystals (QDs), as another system for drug delivery, became an important tool in medicine analysis, particularly for multiplexed, quantitative and semi-permanent light imaging and detection. One in all the foremost vital rising applications of QDs seems to be drug delivery. The essential principle for victimisation QDs arises from their property which might absorb NIR energy and emit their energy to unharness medication. The absorbed lightweight makes associate degree electronic excitation doable within the material, deed the lepton free within the physical phenomenon band. This electron is often returning into the valence band and makes heat [8].

We explained RA during this study mutually of the foremost studied growth factors within the current somatic cell differentiation protocols. In previous studies, high dose of RA (50 μM) has been wont to investigate neural differentiation of stem cells. Though higher doses of RA will manufacture a high proportion of neural cells, RA may be a sturdy agent and may so be used at lower doses to forestall toxicity. We have a tendency to recently use a lower dose (1 μM) of RA to induce neural marker expression in stem cells. However, it ought to be mentioned that additionally one of RA may be a supraphysiological dose and its virulent effects stay to be studied. we have a tendency to believe that the present developed system supported NIR-active QD can facilitate North American nation to decrease the concentration of growth factors to physiological levels (e.g. the vary of 10–100 nM for RA) to realize the specified specific lineage differentiation of stem cells [9].

Conclusion

This hypothesis introduces a brand new approach within the field of controlled protein delivery systems employing a novel quantum dots. During this system, microencapsulated RA that is conjugated to NIR interesting QDs are intercalary to cell culture matrix and also the feasibleness of controlled unharness of protein from microcapsules by external irradiation are evaluated. This method {may be could additionally basis also} used for controlled unharness of not solely RA for somatic cell differentiation however also for the opposite lyophilic medication for numerous clinical applications. We have a tendency to propose here a brand new approach within the field of controlled protein delivery systems that contains chemical compound microencapsulated RA conjugated to close infrared interesting quantum dots. The management unharness of RA from microcapsules within the culture plates are often achieved by irradiation. we have a tendency to believe that this method can facilitate North American nation to decrease the concentration of protein for lineage-specific differentiation of stem cells [10].

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgement

The authors would really like to convey Dr. Ghasem Yazdanpanah for his essential comments. This hypothesis is predicated on our current study on dopaminergic differentiation of amnic animal tissue cells in Nanomedicine and Tissue Engineering research facility of Shahid Beheshti University of Medical Sciences. This work was supported by a grant from the Asian nation National Science Foundation (INSF).

References

1. Koria P (2012) Delivery of growth factors for tissue regeneration and wound healing. BioDrugs Jun 26: 163-175.
2. Sharma P, Kumar A, Dey AD, Behl T, Chadha S, et al. (2021) Stem cells and growth factors-based delivery approaches for chronic wound repair and regeneration: A promise to heal from within. Life Sci 268: 118932.
3. Gainza G, Villullas S, Pedraz JL, Hernandez RM, Igartua M, et al. (2015) Advances in drug delivery systems (DDSs) to release growth factors for wound healing and skin regeneration. Nanomedicine 11: 1551-1573.
4. Wang W, Lu KJ, Yu CH, Huang QL, Du YZ, et al. (2019) Nano-drug delivery systems in wound treatment and skin regeneration. J Nano biotechnology 17: 82.
5. Castaño O, Pérez-Amodio S, Navarro-Requena C, Mateos-Timoneda MÁ, Engel E, et al. (2018) Instructive microenvironments in skin wound healing: Biomaterials as signal releasing platforms. Adv Drug Deliv Rev 129: 95-117.
6. Chouhan D, Mandal BB (2020) Silk biomaterials in wound healing and skin regeneration therapeutics: From bench to bedside. Acta Biomater 103: 24-51.
7. Ribeiro MP, Morgado PI, Miguel SP, Coutinho P, Correia IJ (2013) Dextran-based hydrogel containing chitosan microparticles loaded with growth factors to be used in wound healing. Mater Sci Eng C Mater Biol Appl 33: 2958-2966.
8. Qu Y, Cao C, Wu Q, Huang A, Song Y (2018) The dual delivery of KGF and bFGF by collagen membrane to promote skin wound healing. J Tissue Eng Regen Med 12: 1508-1518.
9. Bienert M, Hoss M, Bartneck M, Weinandy S, Böbel M, et al. (2017) Growth factor-functionalized silk membranes support wound healing in vitro. Biomed Mater 12: 045023.
10. Norouzi M, Boroujeni SM, Omidvarkordshouli N, Soleimani M (2015) Advances in skin regeneration: application of electrospun scaffolds. Adv Healthc Mater 4: 1114-33.