Bioencapslation based on artificial cells : (1) Bioencapsulation of stem cells for regenerative medicine and (2) Bioencapsulation in Nanobiotechnlogy for Nanomedicine

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INTRODUCTION AND OBJECTIVES

Bioencapsulation is already being used in many areas. These include blood substitutes for transfusion, treatment for poisoning, diabetes, liver failure, kidney failure, genetic diseases, endocrine diseases, cancer, drug carriers, nanomedicine, biosensors etc. Nonmedical uses include agriculture, bioengineering, aquatic culture, food industry, environment, nanocomputers , nanorobotics and other areas. (Chang 2005, 2007**;** 2010, 2012).

Two examples of recent research from this laboratory will be given in this presentation:
(1) Bioencapsulation of bone marrow stem cells for liver regeneration (Liu and Chang, 2010, 2012).
(2) Nanobioencapsulation in Nanomedicine for red blood cell substitutes and enzyme therapy (Chang, 2010; Fustier & & Chang 2012).

MATERIALS AND METHODS

Bioencapsulation of bone marrow stem cells
Rat bone marrow stem cells were bioencapsulated inside alginate-polylysine-alginate microcapsules
Nanobioencapsulation of Red blood cell contents or polyhemoglobin-enzymes inside PEG-PLA nanocapsules

RESULTS AND DISCUSSION

Bioencapsulatiion of bone marrow stem cells for liver regeneration
Our results in the following figures show that implantation has led to recovery and liver regeneration in a rat model with 90% liver resected. Even it may take 3 months in human, it will still solve the problem of the 1 year limit of implanted encapsulated cell in the body.

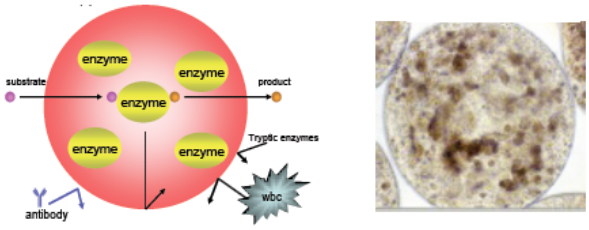

Fig.1 L: Cell bioencapsulation R: bioencap stem cells

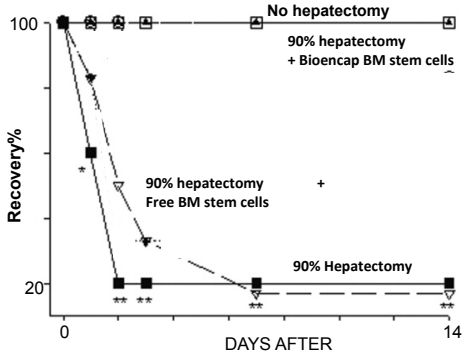

Fig. 2 Recovery of rats with 90% of liver removed surgically

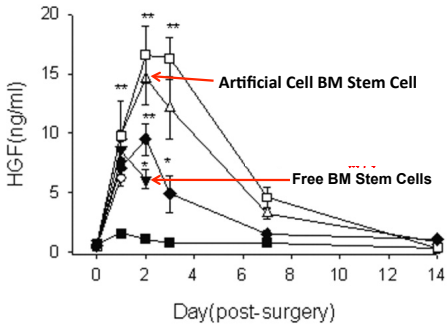

Fig. 3 Plasma levels of hepatic stimulating factor

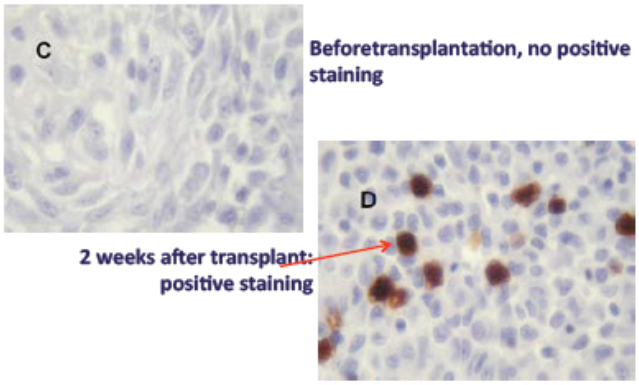

Fig 4 Transdifferentiation of stem cells into liver cells

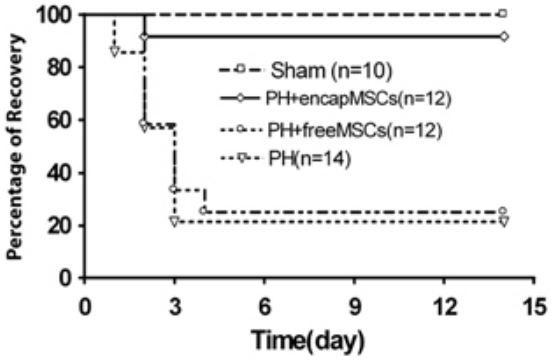

Fig 5 Intrasplenic encap stem cells (PHencapMSCs) on the recovery of rats with 90% liver removed.

PEG-PLA nanocapsules for bioencapsulation: Results in a fully functioning nanodimension artificial rbc with effective circulation time (Chang 2010, 2012) (Figs 6-8).

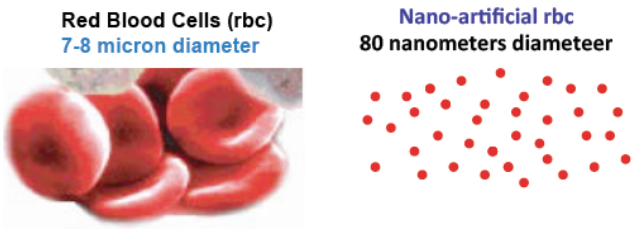

Fig 6 L:red blood cells R: Nanodimension artificial rbcs

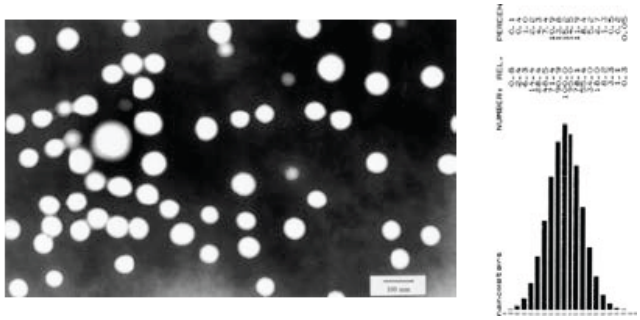

Fig 7. E/M and size distribution of nano rbc

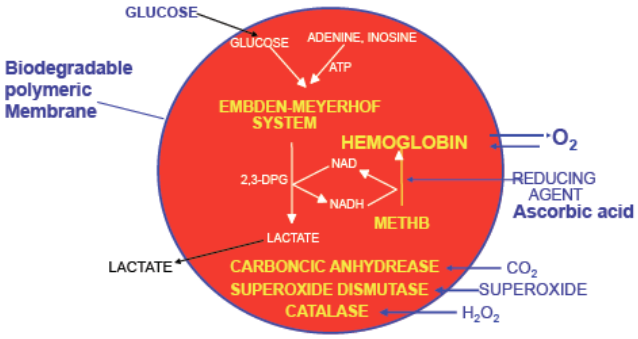

Fig 8 Nano rbc with all the functions of rbc

PEG-PLA nanocapsules containing PolyHb-Tyrosinase for melanoma

We have completed the preparation and charaterisation (Figures 9 -11. We are now studying the effects on human melanoma cells (Wei & Chang).

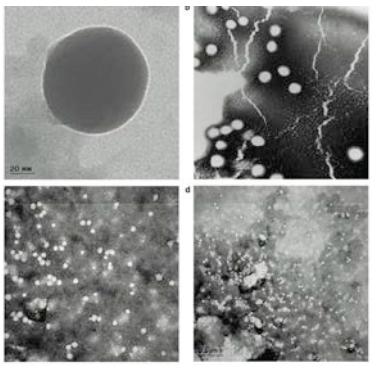

Fig 9 PEG-PLA nanocapsules containing PolyHb-tyrosinase. (mean diameter: 80 nm)

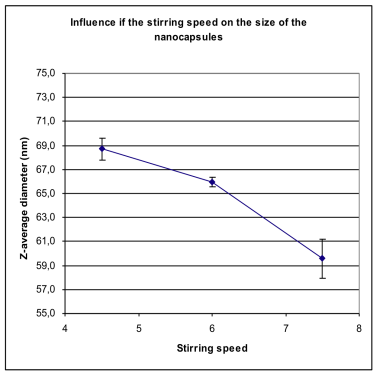

Fig 10 effect of stirring speed on diameter (nm)

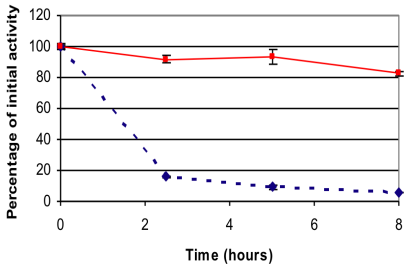

Fig 11 Enzyme stability in PEG-PLA nanocapsules (upper curve) free enzyme (lower curve)

CONCLUSION

Bioencapsulation of stem cells is effective for the regeneration of acute liver failure in a rat model. Further research is needed to analyze its potential in human. Nanobioencapsulation has an important role in Nanomedicine for blood substitutes and biotherapeutics.

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