The chick embryo chorioallantoic membrane (CAM) is an extraembryonic membrane that is commonly used as an in vivo model. Ferromagnetic nanoparticles (FMN) represent an attractive option when it comes to targeted antitumor therapy. The aim of our study was to establish whether CAM is suitable as a model for testing biological properties, such as the biocompatibility and the bioavailability of the FMN.
Cutaneous Adverse Drug Reactions in Hospitalized Patients in Benghazi, Libya

Evaluation of a Teaching Programme in an Acute Medical Unit

Dupuytren’s Contracture- a Review of Pathology and Treatment

A Randomised Control Study on Neurosensory Outcomes of Ilioinguinal Neurectomy in Lichtenstein’s Hernia Repair

Perception of Breastfeeding among Female Medical Students, Taibah University, Medina, Saudi Arabia 2012

Biocompatibility of Fe3O4 Nanoparticles Evaluated in vivo

Impact of a one-day teaching course on invasive procedures training in foundation year doctors
Biocompatibility of Fe$_3$O$_4$ Nanoparticles Evaluated in Vivo

Dr Croitor D; Dr Mîndrilă I; Dr Laura P

Institution
Morphological Sciences
Department, University of Medicine and Pharmacy of Craiova

Abstract
Introduction: The chick embryo chorioallantoic membrane (CAM) is an extraembryonic membrane that is commonly used as an in vivo model. Ferromagnetic nanoparticles (FMN) represent an attractive option when it comes to targeted antitumor therapy. The aim of our study was to establish whether CAM is suitable as a model for testing biological properties, such as the biocompatibility and the bioavailability of the FMN.

Material & methods: Ten Eggs of White Leghorn chicken were incubated at 37.8°C for 13 days, in order to proceed to one or two daily intravascular injection of 0.2 ml of FMN for two consecutive days. Three embryos have been harvested on the second day after injection. Seven eggs were left incubated until the hatching stage. The harvested embryos have been sent for further histopathological studies H&E and Perls stainings.

Results: Injected embryos underwent a normal evolution and as a result a proper hatching. Histological studies have shown FMN deposits in the liver, as well as free nanoparticles in the blood stream.

Conclusions: The uninfluenced development of the injected embryos can be considered as a proof of biocompatibility and an open door for further studies. FMN deposits in viscerae can also be considered as a feasible biocompatibility.

Key Words
Biocompatibility; Bioavailability; Ferromagnetic nanoparticles; Embryo; CAM

Corresponding Author:
Dr Croitor D: E-mail: dan.kr67@gmail.com

Introduction
The chick embryo chorioallantoic membrane (CAM) have been used as a model for studying development, biomaterial’s properties, angiogenesis, photodynamic therapy, human tumor cell invasion and metastasis, microsurgical interventions.$^{1-2}$ Chick embryo CAM is an extraembryonic membrane that is commonly used as an in vivo model.$^3$ It offers an optimal access to a capillary rich vascular system (Figure 1), together with easy manageability, fast development and inexpensive costs. Ferromagnetic nanoparticles (Figure 2) are less than 1 micrometer particles and contains magnetic elements which allow us to manipulate them using magnetic field.$^4$ Thus, they represent an attractive option when it comes to targeted antitumor therapy.$^5$ The aim of our study was to find out whether the CAM is suitable as a model for testing biological properties, such as the biocompatibility and the bioavailability of the
ferromagnetic nanoparticles (FMN).

**Material and Methods**

**Chick chorioallantoic membrane model**

A number of ten White Leghorn chicken fertilized eggs were incubated in optimal conditions for hatching (37.8°C and 70% relative humidity) for 13 days, in order to proceed to one or two daily intravascular injection of 0.2 mL of FMN for two consecutive days (Figure 3). The eggs were daily examined and registered by a Carl Zeiss stereomicroscope equipped with a DCM 510 camera system. Three embryos have been harvested on the second day after injection. Seven eggs were left incubated until the hatching stage, additionally to analyse any potential morphological abnormalities that could appear during the embryos development. Blood samples, as well liver tissue samples of the harvested embryos where formaldehyde (4%) fixed and paraffin - embedded for further histopathological studies using hematoxylin-eosin and Perls stainings.

**Results**

**In vivo observation**

Injected embryos underwent a normal evolution and as a result a proper hatching, without showing any morphological abnormalities.

**Histological analysis**

Histological studies have shown free nanoparticles deposits in the liver (Figure 4) and Kupffer & Hepatocytes cells (Figure 5), as well as free nanoparticles in the blood stream (Figure 6). Nanoparticle deposits from the liver were dose-dependent.

**Discussion and Conclusions**

In this study we have shown that chick embryo chorioallantoic membrane is suitable as a model for testing biocompatibility and bioavailability of ferromagnetic nanoparticles, due to unaffected development of the embryos and large distribution throughout the fluids and tissues of the body. Nanoparticle interactions with biological systems still remains relatively unknown, although their ability of cell membrane penetration has been proven (6). Such feature as high surface to volume ratio makes them very catalytic, which seems to be a strong argument against their biosafety7. However, in our study chick embryos injected with FMN hatched and survived without any morphological abnormalities.
In conclusion, the uninfluenced development and hatching of the embryos injected with FMN can be considered as a proof of biocompatibility and an open door for further studies. Nanoparticle deposits in viscerae can also be considered as a feasible biocompatibility. Nevertheless, caution should be exerted when extrapolating these results to another animal model or human system. As a limitation of our study are the unknown long-term effects on development of the chick.

References
The World Journal of Medical Education & Research (WJMER) is the online publication of the Doctors Academy Group of Educational Establishments. It aims to promote academia and research amongst all members of the multi-disciplinary healthcare team including doctors, dentists, scientists, and students of these specialties from all parts of the world. The journal intends to encourage the healthy transfer of knowledge, opinions and expertise between those who have the benefit of cutting-edge technology and those who need to innovate within their resource constraints. It is our hope that this interaction will help develop medical knowledge & enhance the possibility of providing optimal clinical care in different settings all over the world.