Method to Direct the Reciprocal Interactions Between the Ureteric Bud and the Metanephric Mesenchyme

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SUMMARY

Researchers at UCLA have developed an approach to construct an embryonic kidney *in vitro* for the treatment of end stage renal disease.

BACKGROUND

End stage renal disease (ESRD) is a fatal illness characterized by the permanent loss of kidney function that affects 1.6 million people worldwide. Every year, approximately $32 billion dollars is spent on treating ESRD patients. Currently, the preferred treatment for ESRD is kidney transplantation, which is limited by the shortage of donor organs and complications due to rejection and immunosuppression. Furthermore, the use of dialysis, the second treatment option for ESRD, presents a tremendous financial burden and is associated with poor quality of life and a high morbidity rate. Regenerative medicine is working towards developing novel methods to overcome these limitations through in vitro kidney organogenesis.However, the structural complexity of the adult kidney imposes an insurmountable hurdle against any attempt to construct a functional adult kidney by conventional tissue engineering strategies. Therefore, there is an urgent need for alternative novel treatments for ESRD patients.

INNOVATION

UCLA researchers in the laboratory of Dr. Yanagawa have developed a method to construct an embryonic kidney *in vitro* for the treatment of ESRD. The present invention utilizes developmental engineering principles to generate kidney progenitor cells to construct and control kidney development on the cellular level. Proper formation of the kidney requires the three main cell types, the ureteric bud (UB), the metanephric mesenchymal (MM) cells, and the stromal (SM) cells, to interact in a highly organized and specific manner. Although previous research has demonstrated that UB and MM cells are capable of forming primitive kidney structures *in vitro*, the method is not sufficient to create a functional organ due to the inability to control the interaction between these three cell types.

The present invention circumvents these difficulties by providing a platform whereby the interaction of UB, MM and SM cells is tightly regulated. The controlled environment mimics the developmental process in the embryo and thereby generates an organized embryonic kidney *in vitro*. The *in vitro* generated embryonic kidneys will be implanted back to the patient where they will develop into adult kidneys. This will help to relieve that donor shortage with shortened waiting time, and since these kidneys consist of patient tissue, the risk of tissue rejection is practically non-existent, which subsequently reduces the need for life-long immunosuppressive therapy.

APPLICATIONS

- Construction of an embryonic kidney *in vitro* for kidney transplantation.
- Embryonic kidney can be used to study kidney development, drug toxicity and the effect of pharmacological substances on kidney function

ADVANTAGES

- The present invention supports the self-organization potential of the renal progenitor cells and allows the generation of embryonic kidney tissue *in vitro* with the potential to drain urine and thus functions as an excretory organ.
- Due to the high similarity of the developmental process of the kidney in mammals, the present invention can be applied to generate embryonic kidneys *in vitro* in other mammal species, such as mouse, rat, sheep, pig, apes and human.

STATE OF DEVELOPMENT

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Hauser, Peter V.
- Hauser, Peter V.

OTHER INFORMATION

KEYWORDS

Transplantation, transplant, stem cells, tissue enginering, organogenesis, stem cell therapy, cell therapy, in vitro, Kidney, ureteric bud (UB) and the metanephric mesenchymal (MM) cells, tissue rejection, transplantation, stem cells, progenitor cells, immunosuppressive, renal, end stage renal disease, ESRD, kidney failure, renal insufficiency, kidney disease, chronic kidney disease, CKD, chronic renal disease

CATEGORIZED AS

- **Biotechnology**
  - Genomics
- **Engineering**
  - Engineering
  - Other
- **Medical**
  - Disease: Cancer
  - Disease: Central Nervous System
  - Disease: Kidneys and Genito-Urinary System

Renal development has been observed from the cultured cells *in vitro*. The generated structure can be implanted into an animal for further development.

RELATED MATERIALS

- Nishikawa, M., Yanagawa, N., Kojima, N., Yuri, S., Hauser, P. V., Jo, O. D., Yanagawa, N. Stepwise renal lineage differentiation of mouse embryonic stem cells tracing in vivo development, 2012.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,369,254	08/06/2019	2013-369

- Gene Therapy
- Research Tools
- Stem Cell
- Therapeutics

Research Tools

- Cell Lines
- Expression System
- Other

RELATED CASES

2013-369-0

UCLA Technology Development Group

10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095

https://tdg.ucla.edu

Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu