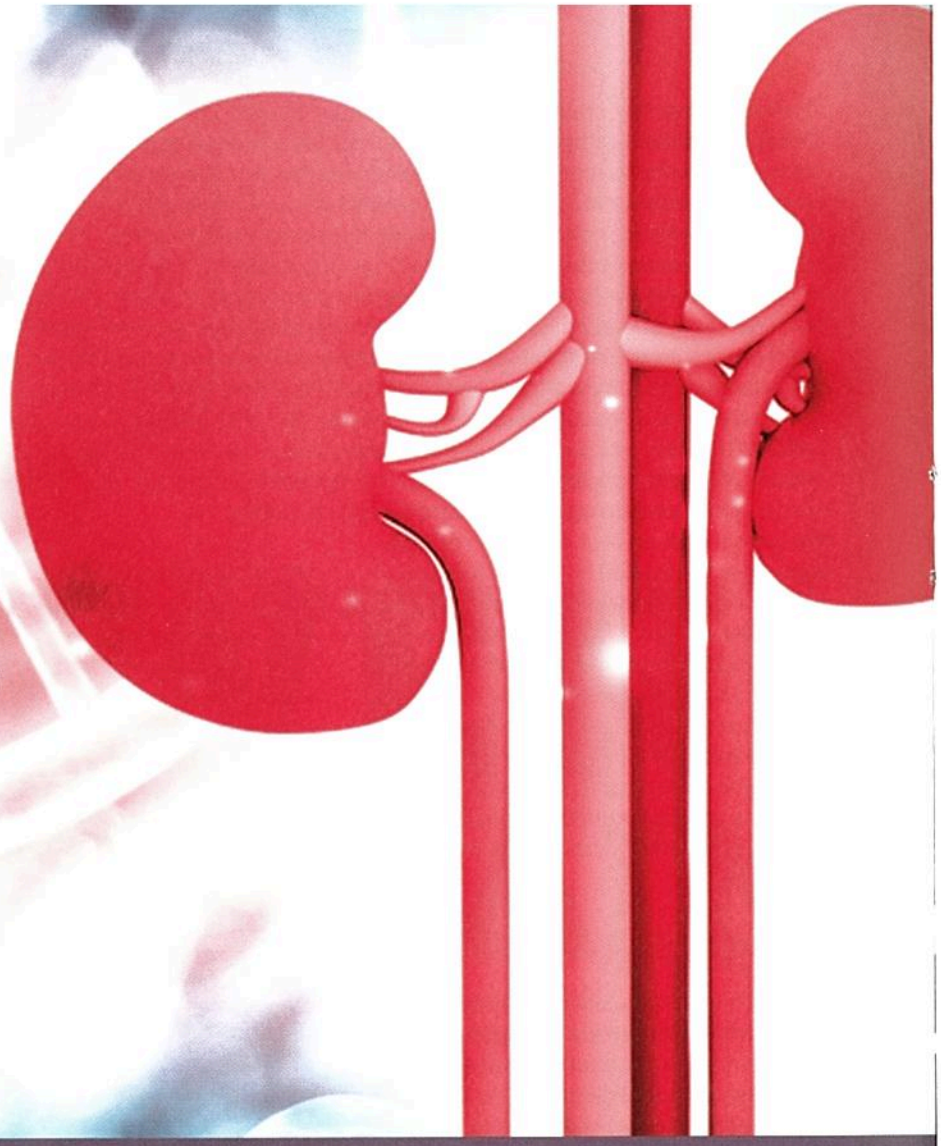

Within a couple of decades, the field of systems biology will probably have a full computational model of the human body available to speed up disease analysis and drug development. SysBioSim in Leiden is already developing a partial model of the kidney on the molecular level. Within a Public Private Partnership with the CWI, the team is adding the cellular level to the model. Within four to five years, CEO Basak Tektemur Altay expects the virtual kidney platform will be used thoroughly in the battle against kidney fibrosis.

By Leendert van der Ent

DRAWING THE BODY BY NUMBERS

SysBioSim at the Leiden Bioscience Park specialises in mathematical modelling of metabolic and signalling pathways. 'We analyse drug candidates and active food ingredients on computer platforms. In that way we complement and help to refine animal studies and clinical trials. As a result, the time and cost of the drug development process are reduced for our clients, which are mostly pharmaceutical companies,' CEO Tektemur Altay explains.
'With our platform, you can directly study the effects of drugs on humans, without harming the human volunteers in clinical trials. Furthermore, our systems biology approach reduces animal studies not only for the sake of animal rights, but also has an edge over animal studies as animal models are often inaccurate for humans. Furthermore, systems biology simulations are more effective, as they are able to result in better leads and more efficient treatments. This field, although in its infancy, helps solving major health problems,' she says.

Virtual human body

In November 2016, the CWI in Amsterdam and SysBioSim partnered up. Tektemur Altay: 'We are fully complementary. In the collaboration we add our knowledge of molecular modelling and simulation capabilities to CWI's knowledge of modelling on the multicellular level. This combined knowledge creates true added value, as CWI Senior researcher and Leiden University professor Roeland Merks

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remarks: 'CWI's multi-scale modelling strategies will help predict how pharmacologically active compounds can change the structure of kidney tissues in a potentially harmful way.'
Tektemur Altay: 'The platform eventually will also include modelling on the tissue level and the physiological level: that way we can simulate an entire organ.' For the liver, such a computational approach already exists. But since the kidney is an extremely complex organ, not much work has been done before to model this organ as a whole.

The ultimate goal of the systems biology community is to develop a complete virtual human body. It is hard to predict when this will be available, but this will probably take another couple of decades.

Two levels

At present, the multi-scale models being developed by SysBioSim and CWI are especially tuned for research on understanding the mechanism behind kidney fibrosis in order to develop drugs against this disease. Essential questions have to be answered: How does the disease proceed? What mechanisms are at play, which molecules and cell types are involved? This kind of basic understanding might reveal leads for therapies that could slow down or even regress the disease. 'We have achieved very promising preliminary results towards the development of a multi-scale kidney model,' Tektemur Altay says about this line of work.

A second very useful application, at

ments of chronic conditions may often lead to kidney diseases such as kidney fibrosis and even kidney failure. Our proposed virtual kidney platform can offer a targeted way to test and hopefully avoid the adverse events on kidneys by drugs used in the treatment of chronic conditions as well as contribute to the development of new therapies against kidney fibrosis. Because of these two levels of benefits, we expect that our virtual kidney platform can have an even larger impact.'

New strategies

The computational sciences are progressing fast. Nevertheless, Tektemur Altay still sees some potential ICT challenges in biotechnology: 'We might be approaching the physical limits of computational power. This challenges us to develop more efficient new algorithms. However, we trust that computer science will come up with a sustainable growth model in computational power as it has done over the last decades.' So with the progress of research over time, more fruits can be reaped from systems biology in general and SysBioSim's computational platforms in particular. 'Whole tissue testing with multi-scale models will be of key interest to public health and the pharmaceutical industry,' Merks says. 'I believe our collaboration with SysBioSim will contribute to the development of these much needed new strategies.'

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