DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CBM352 Human Assist Devices

UNIT-III ARTIFICIAL KIDNEY

3.4 Implanting type artificial Kidney

the development of implantable artificial kidneys, also known as bioartificial kidneys or implantable renal devices, was an area of ongoing research, but no fully functional and widely adopted implantable artificial kidney was available at that time.

The idea behind implantable artificial kidneys is to create a device that can mimic the essential functions of a natural kidney, such as filtration and regulation of electrolytes and fluid balance. These devices are intended to provide a long-term solution for individuals with end-stage renal disease (ESRD), potentially eliminating the need for regular dialysis.

Here are some key considerations and challenges associated with implantable artificial kidneys:

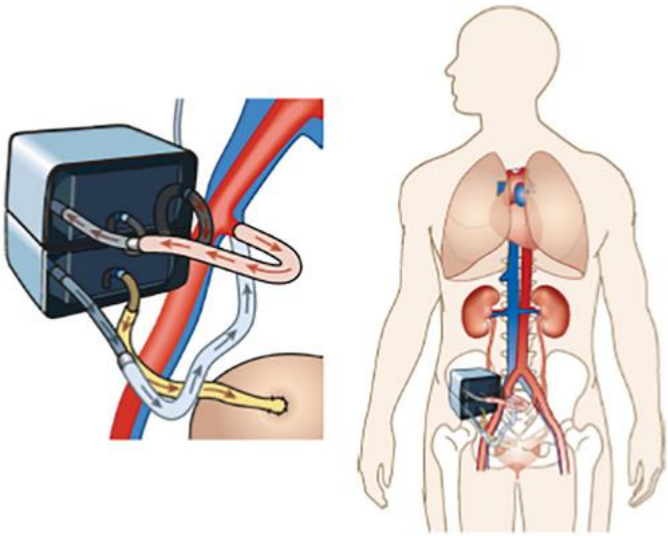
1. **Biocompatibility**: The implantable device must be biocompatible to ensure that it does not trigger an immune response or cause adverse reactions within the body.
2. **Filtration Technology**: Researchers have been exploring different filtration technologies to replicate the selective permeability of the glomerulus in the natural kidney. This involves developing membranes capable of efficiently removing waste products and excess fluids from the blood.
3. **Regulation of Electrolytes**: An artificial kidney needs to regulate electrolytes and maintain appropriate fluid balance in the body. This requires sophisticated control mechanisms.
4. **Power Supply**: Implantable devices must address the challenge of a power source. This may involve exploring options such as wireless power transfer or miniaturized, long-lasting energy sources.

5. **Biological Components**: Some approaches involve incorporating living cells or tissues into the device to enhance its functionality. This introduces the concept of bioartificial kidneys.

While there have been promising developments in the field, including successful experiments in animal models, creating a fully functional and reliable implantable artificial kidney for human use remains a complex challenge.

It's important to check more recent and specialized sources for updates on this topic, as advancements in medical technology can occur rapidly. Researchers and scientists are continuously working to overcome the technical and biological challenges associated with implantable artificial kidneys to improve the options available for individuals with kidney failure. Patients interested in such technologies should stay informed about the latest developments and discuss potential options with their healthcare providers.

An IAK, (shown in Figure), must achieve two key goals: waste elimination and homeostasis of the extracellular fluid volume. IAK thus are organized around a thoughtful selection of functions, a balance of engineering and pharmacologic solutions to host tolerance, and life cycle management strategies that mitigate the burden on patients. From their initial conception, designers of implantable bioartificial kidneys must select which of the dozen or more functions of the mammalian kidney they are to perform. Some functions of the kidney are completely dispensable as they are redundant (water balance can be and is regulated by thirst alone) or easily substituted by pharmacologic means (erythropoietin, vitamin D, hydroxylation). Other functions are essential (concentrating wastes from low concentration in the blood to high concentration in effluent) and still others may need to be consciously and continuously regulated by the patient or physician (potassium concentrations, extracellular fluid volume).



Scheme of an implantable artificial kidney (IAK). The iliac vessels are used as intake of the arterial blood and outlet for the venous blood, while the removed waste is shunted to the bladder.

the IAK will represent a combination of a filtration device, small enough to be implantable, but with a surface area large enough to achieve the desired filtration function of kidney glomeruli, and a bioreactor filled with kidney epithelial cells that resemble the function of kidney tubules. Implantable filtration devices that address these requirements can be produced by photolithographically production of membranes made from silicon wafers, adjusting slit-shaped pores of 5–10 nm width with a precision and size distribution greatly exceeding that of conventional polymer membranes.

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