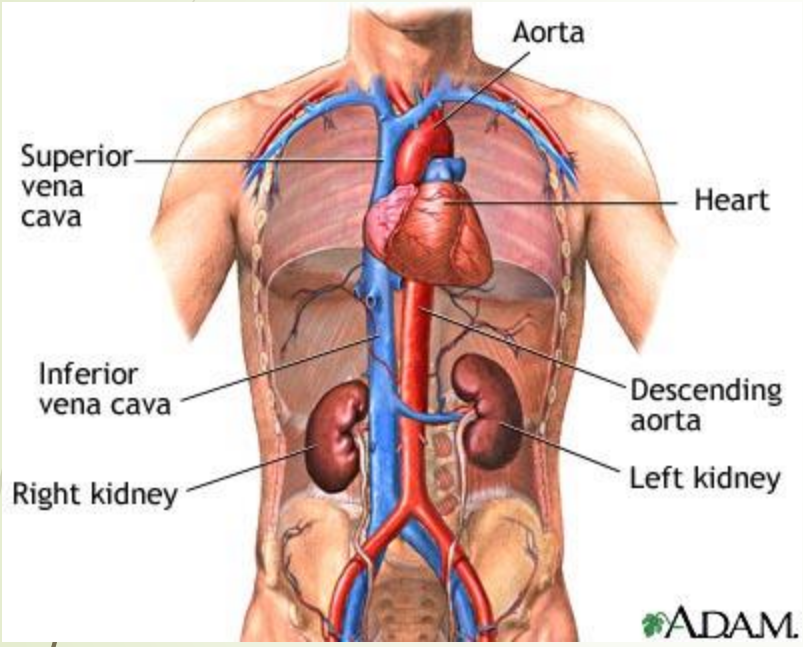
Implantable Artificial Kidney

By: Dr. Usama Alanan
Manara university
23 march 2022

The Function of the Kidney



- The kidneys are located near the middle of the back, just below the ribcage, one on each side of the spine.
- Daily, a person's kidneys process about 200 quarts of blood to sift out roughly 2 quarts of waste products and extra water.
- The wastes and extra water become urine, which flows to the bladder.

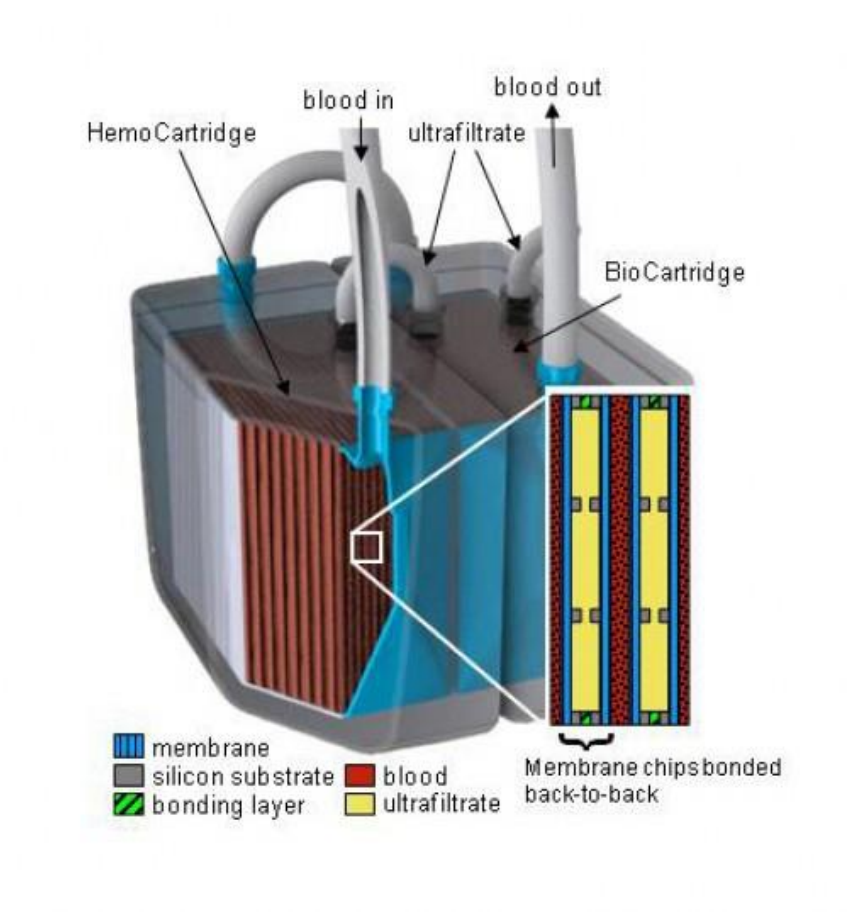
Causes of Kidney Failure

- Kidneys lose their filtering capacity when they fail.
- **Acute Kidney Injury** – losing a lot of blood can cause sudden kidney failure; drugs/poison; a sudden drop in the kidney functioning.
- **Chronic Kidney Failure** – gradual loss of kidney function; may go on to develop permanent kidney
- Failure and are at a high risk of stroke/heart attack.
- End Stage Renal Disease – (renal meaning how the kidneys filter blood); total or nearly total and permanent kidney failure; must undergo dialysis or transplantation to stay alive.

History of the Artificial Kidney

- University of California-San Francisco researchers unveiled a prototype model of the first implantable artificial kidney on September 2, 2010.
- Led by Shuvo Roy, PhD, in the UCSF Department of Bioengineering and Therapeutic Sciences.
- **First Phase** (already completed) – focused on developing the technologies required to reduce the device to a size to be tested by animals.
- **Second Phase** (current) – doing the work needed to scale up the device for humans.
- Received $3 million in funding as of October 1, 2012.
- Plan to go through human clinical trials by 2017.

Current State



- **Two Stage System:**
- First compartment holds thousands of nano-scale filters remove toxins from the blood (dialysis).
- A second compartment would hold live kidney cells that perform the other biological actions of a real kidney.
- The entire device would be implanted in the abdomen and powered by the body's blood pressure, without a need for external pumps or tubes.

The Artificial Kidney Project

- Very new device and is not on the market yet
- No price set on it yet
- Inventor Dr. Shuvo Roy of UCFS says it will be the same or a little less than a kidney transplant

- توافق الدم مع طبقة رقيقة من البوليمر
- تم تمكين مفاعل حيوي خلوي عن طريق عزل خلايا الأنابيب الكلوية
- القدرة على توفير الوظائف المرتبطة بخلايا الأنابيب القريبة
- يمكن أيضًا استعادة الشوارد والملح والسكر


THE
KIDNEY
PROJECT

Stem Cell Therapy for Kidney Disease

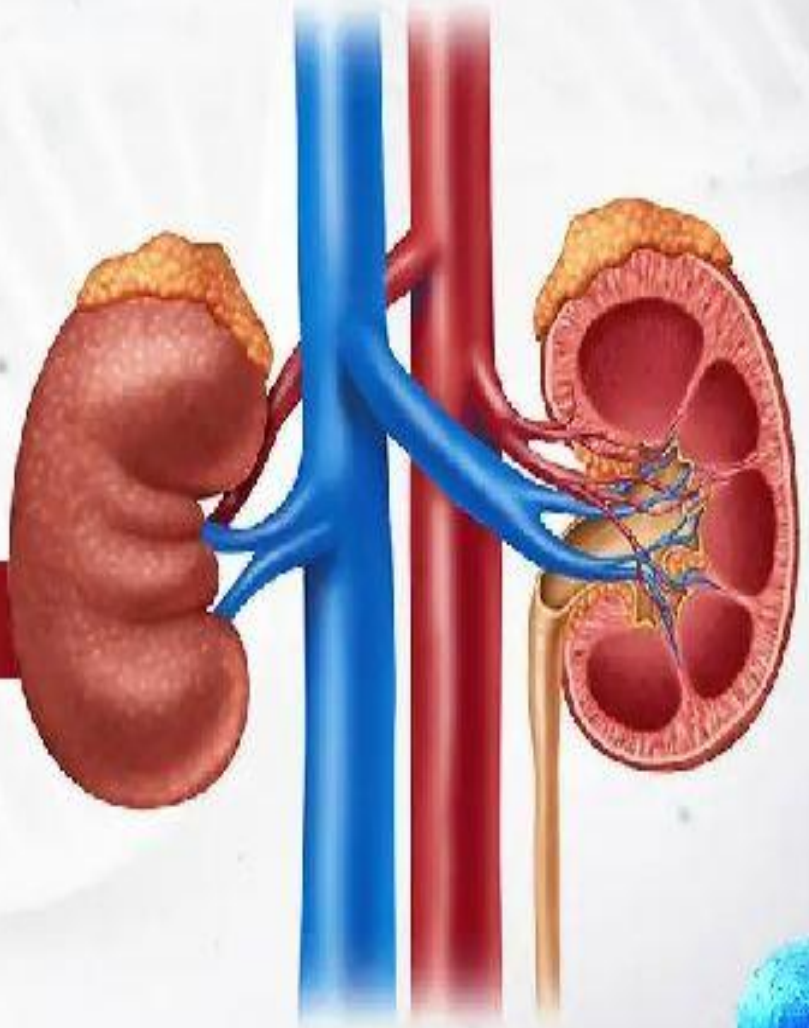
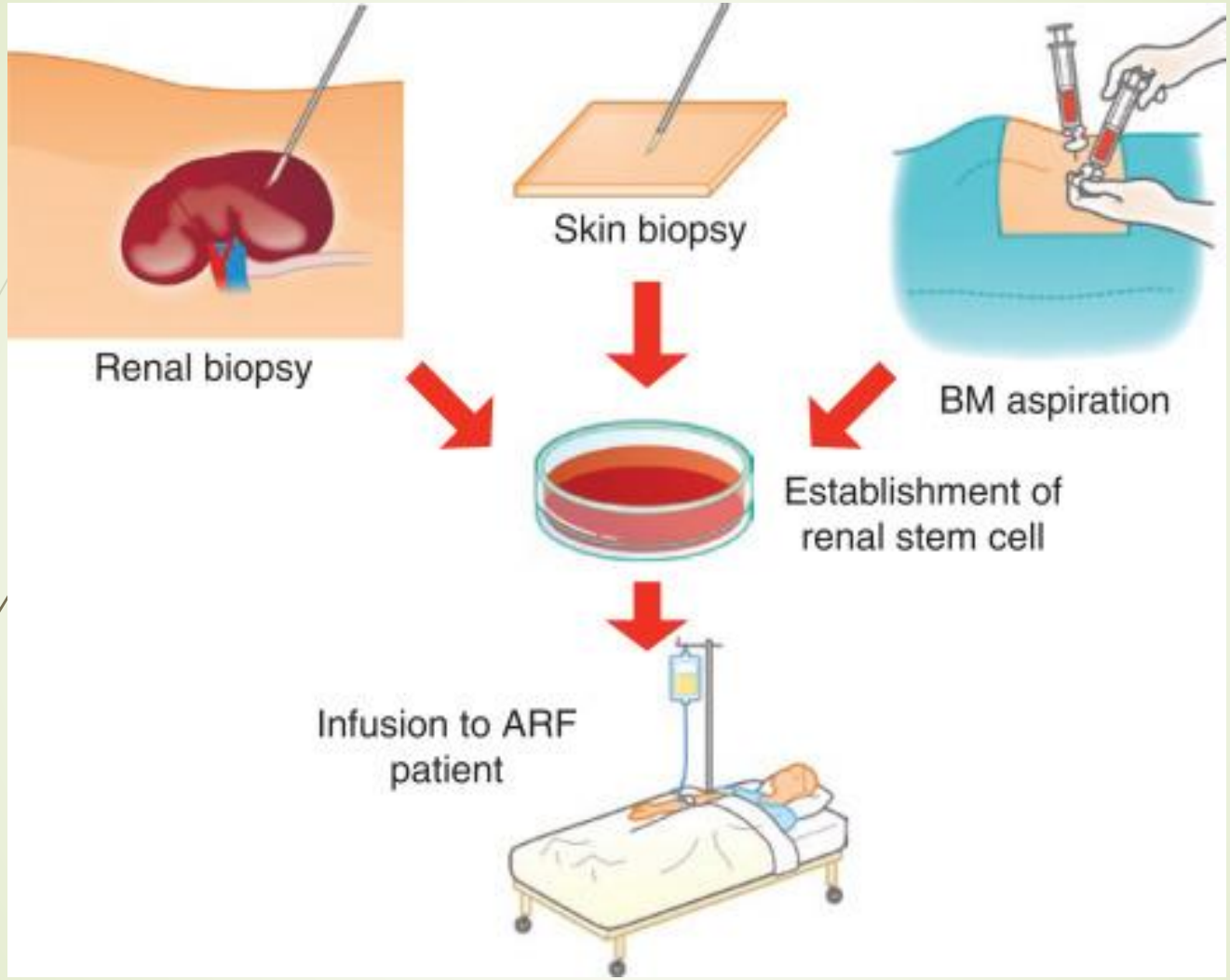
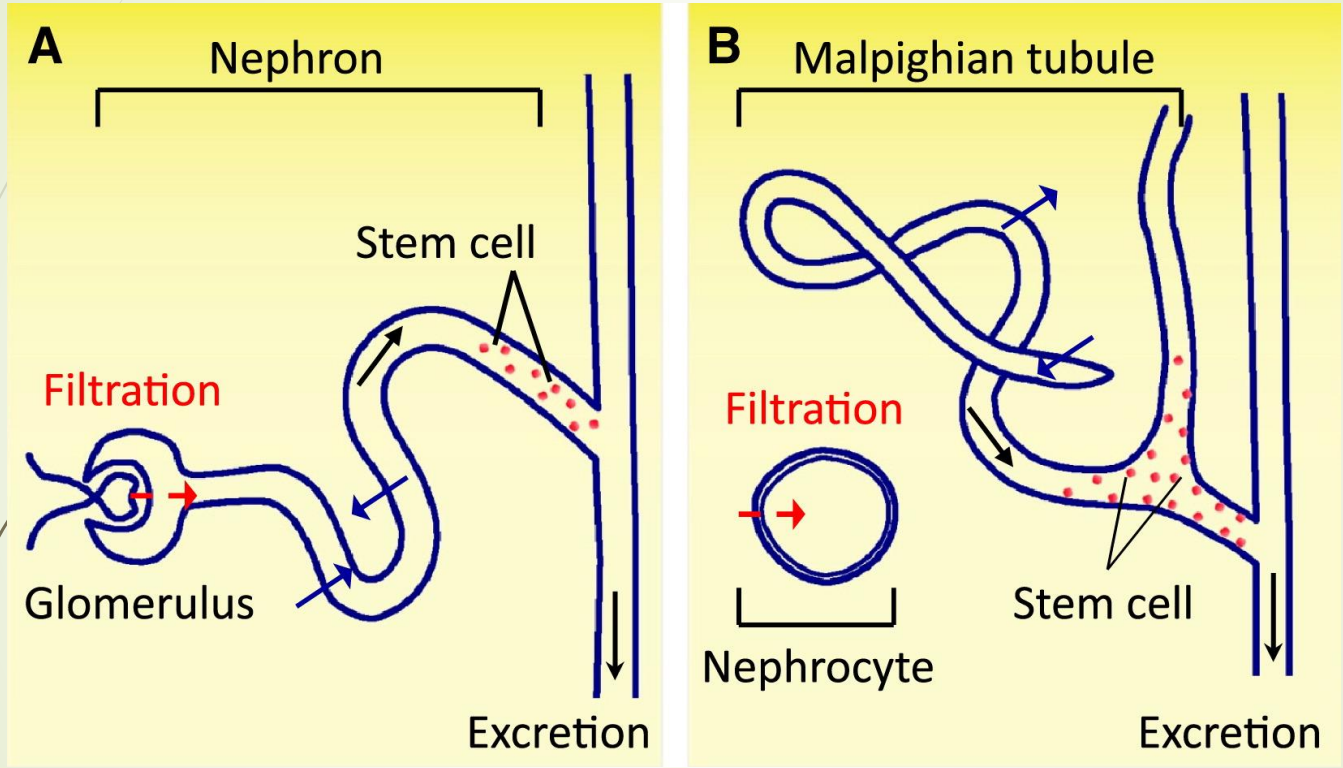


Figure 1



Kidney International 2008 74, 847-849DOI: (10.1038/ki.2008.327)

Figure 1



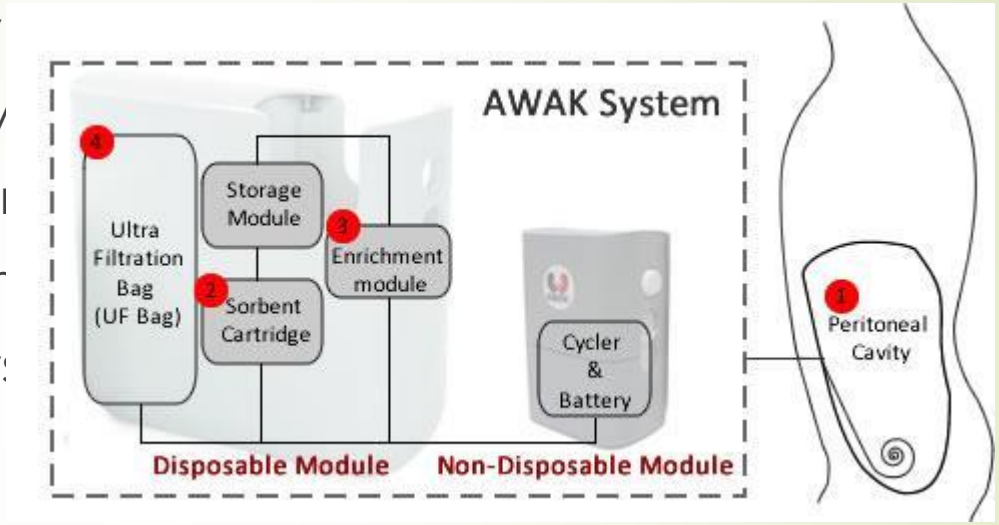
Cell Stem Cell 2011 8, 247-249DOI: (10.1016/j.stem.2011.02.008)

What it Plans to Solve

- Plans to replace **dialysis** (blood is pumped through an external circuit for filtration; typically three sessions per week, 3-5 hours per session.)
- U.S. Medicare system spends upwards of $29 billion per year (6 percent of its total budget) to treat kidney failure.
- $24 billion each year to pay for dialysis.
- Allows the patient to live a more normal lifestyle; takes less of a toll on them than normal from today's dialysis.
- Maintain water and salt balances, produce Vitamin D, and regulate blood pressure.

AWAK dialysis

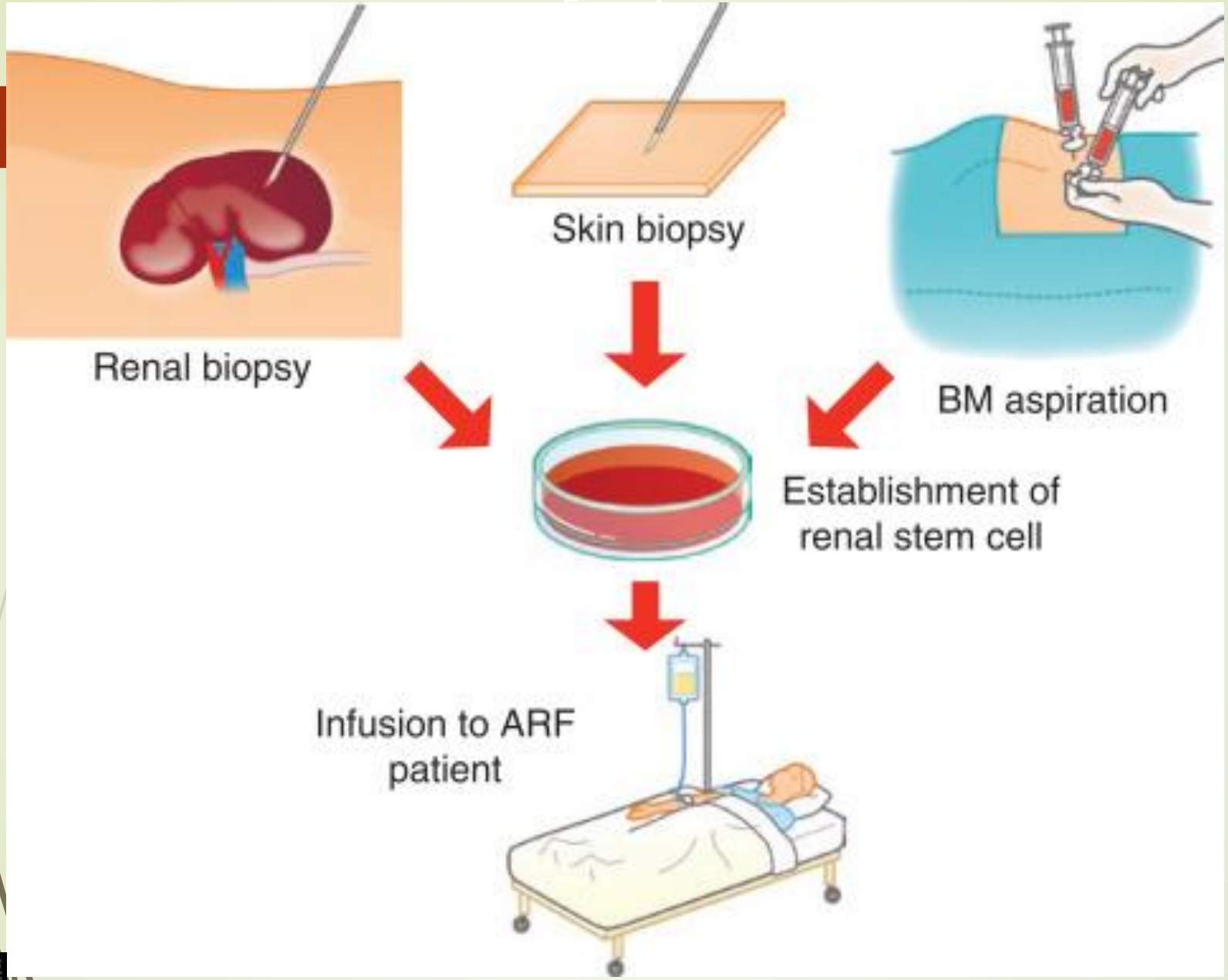
- used dialysate automatically
drained from peritoneal cavity
and filtered through the **sorbe**
cartridge, which removes toxir
to produce regenerated dialy
- the **Enrichment Module** adds
electrolytes and glucose to
dialysate before it is returned to the peritoneal cavity



- These 3 steps are repeated until the Sorbent Cartridge is exhausted, at which point the old Disposable Module is replaced (2-3 times a day)
- in Ultra-filtration mode, the dialysate from the peritoneal cavity is emptied into the ultrafiltration bag and some determined amount of dialysate is returned to the peritoneal cavity, at which point AWAK returns to dialysis mode.

Challenges

- chance of infection (as in traditio
peritoneal dialysis) because of
catheter continuously in peritonea
space
- still have to change the cartridge
a few times a day
- must wear a bulky belt all day



Kidney International 2008 74, 847-849DOI: (10.1038/ki.2008.327)

SPECIAL COLLECTION

World Kidney Day

10 MARCH 2022

Kidney Health for All

#worldkidneyday #kidneyhealthforall

www.worldkidneyday.org

World Kidney Day 2022

Bridge the knowledge gap to better kidney care.

World Kidney Day is a joint initiative of ISN IFKF-WKA