Extracorporeal Artificial Organs [HW10]

Definition + Examples

An extracorporeal artificial organ is a man-made device that is integrated into a human — interfacing with living tissue — to replace a natural organ, for the purpose of duplicating or augmenting a specific function or a group of related functions so the patient may return to a normal life as soon as possible. The replaced function doesn't necessarily have to be related to life support, but it often is.

Most of artificial organ technologies perform mass transfer operations to support failing or impaired organ systems. One of the oldest and most widely employed kidney substitute is hemodialysis. Other renal assist systems can also be identified, such as hemofiltration for the treatment of chronic renal failure and fluid overload and peritoneal dialysis (a type of hemodialysis performed inside of the peritoneal cavity). Additionally, the blood treatment process of hemoperfusion and apheresis technologies which include plasma exchange, plasma treatment, and cytapheresis—used to treat metabolic and immunologic diseases. In addition, blood—gas exchangers, as required for heart-lung bypass procedures and bioartificial devices that employ living tissue in an extracorporeal circuit are also of capital importance. Significant concerns associated to technological considerations regarding these technologies, including blood access, anticoagulation, the effects of the extracorporeal circulation, including blood cell and humoral changes, and the biomodulation effects of the procedure and materials of blood contacts must carefully analyzed to obtain desirable results.

Artificial Kidney | Hemodialyzer

Hemodialyzer or artificial kidney, is used to filter fluids (e.g. free water) and wastes (e.g. urea and creatinine) from a dialysis patient's blood. Hemodialysis is the technique which uses the hemodialyzer to remove excretions that kidneys partially or totally cannot. This is only one of three renal replacement therapies (the other two being kidney transplant and peritoneal dialysis) that can be used to achieve the same end.

Hemodialysis can be an outpatient or inpatient therapy. Routine hemodialysis is conducted in a dialysis outpatient facility, either a purpose built room in a hospital or a dedicated, stand-alone clinic. Less frequently hemodialysis is done at home.

The newest dialysis machines on the market are highly computerized and continuously monitor an array of safety-critical parameters, including blood and dialysate flow rates; dialysis solution conductivity, temperature, and pH; and analysis of the dialysate for evidence of blood leakage or presence of air. Any reading that is out of normal range triggers an audible alarm to alert the patient-care technician who is monitoring the patient. [Fig. 1]

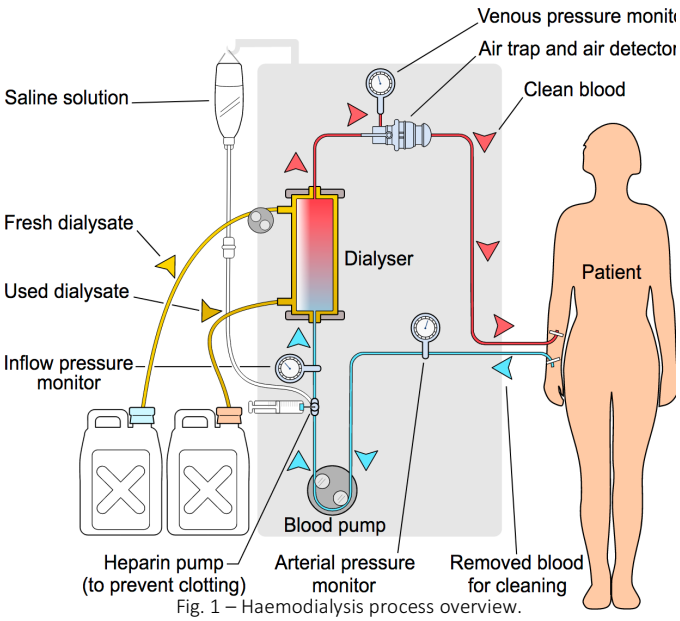

Fig. 1 – Haemodialysis process overview.

Artificial Lung | ECMO

Extracorporeal membrane oxygenation is an extracorporeal technique of providing both cardiac and respiratory support to people whose heart and lungs are unable to provide an adequate amount of gas exchange to sustain life.

This intervention has mostly been used on children, but it is seeing more use in adults with cardiac and respiratory failure. ECMO works by removing blood from the person's body and artificially removing the carbon dioxide and oxygenating red blood cells. Generally, it is only used in the later treatment of a person with heart or lung failure as it is solely a life-sustaining intervention.

Once it has been decided that ECMO will be initiated, the person is anticoagulated with intravenous heparin and then the cannulae are inserted. ECMO support is initiated once the cannulae are connected to the appropriate limbs of the ECMO circuit. Cannulae are usually placed percutaneously by the Seldinger technique. The largest cannulas that can be placed in the vessels are used in order to maximize flow and minimize pressures. Finally, following cannulation, they are connected to the ECMO circuit and the blood flow is increased until respiratory and hemodynamic status is stable. [Fig. 2]

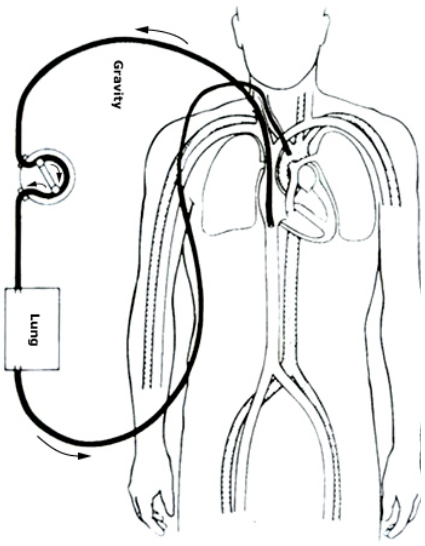

Fig. 2 – Veno-arterial EMCO setup.

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References

[1] Wikipedia, "Extracorporeal membrane oxygenation". Available at: https://en.wikipedia.org/wiki/Extracorporeal_membrane_oxygenation (Consult. 07/05/2017);

[2] Wikipedia, "Hemodialysis". Available at: https://en.wikipedia.org/wiki/Hemodialysis (Consult. 07/05/2017);

[3] Kidney, "What You Should Know About Dialyzer Reuse". Available at: https://www.kidney.org/sites/default/files/docs/dialyzer_reuse.pdf (Consult. 07/05/2017);

[4] Click to Cure Cancer, "Extracorporeal artificial organs". Available at: https://www.clicktocurecancer.info/molecular-weight-2/extracorporeal-artificial-organs.html (Consult. 07/05/2017);

[5] Wikipedia, "Artificial organ". Available at: https://en.wikipedia.org/wiki/Artificial_organ (Consult. 07/05/2017).

Quiz

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