

# تکنیک های انجام پلاسمافرزیس

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رشت

# apheresis

- a technique by which a particular substance or component is removed from the blood, the main volume being returned to the body.

# Therapeutic apheresis

- therapeutic plasma exchange (TPE) •
- cytapheresis 0
- photopheresis •

Generally, in PEX, blood is pumped out of the patient's circulation and is transferred to the filter, separating plasma from blood cells.

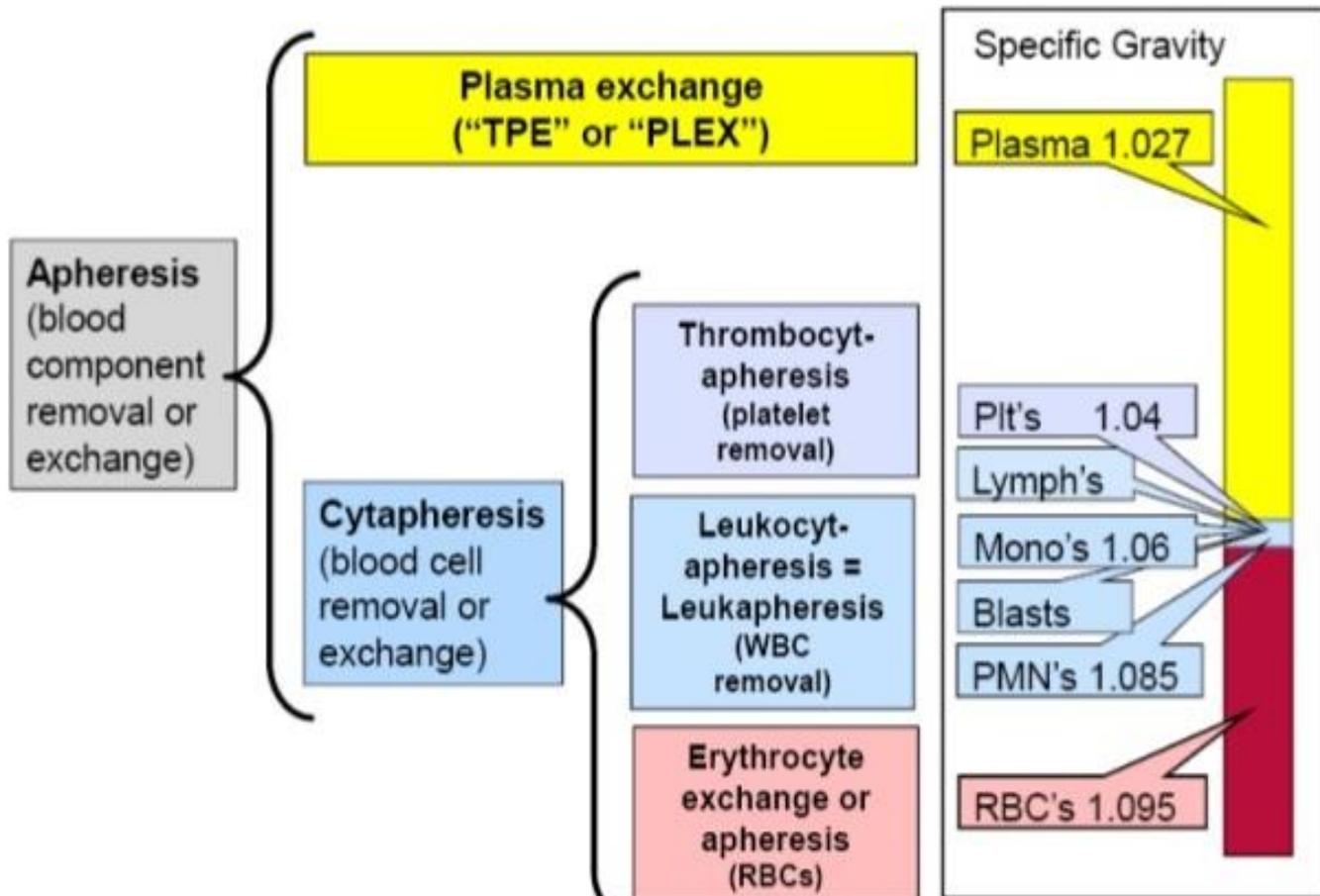
Afterwards, blood cells are pumped into the patient's vein. Patient's plasma is substituted by human albumin and/or FFP.

Plasma exchange (PEX) is an invasive therapeutic method, separating plasma from blood cells. Thus, pathogenic antibodies or other large molecules are removed and plasma is replaced by human albumin and/or fresh frozen plasma (FFP). The method was first developed in the first half of the twentieth century.

Over the years a significant improvement in the PEX technique, patient safety and broadening of indications were observed. Selective techniques were also introduced into practice, leading to selective removal of proteins and reduction of protein loss during the standard procedure, especially fibrinogen. Thus, improved effectiveness and patient safety was achieved.

سیتا فرزیس خارج ساختن یکی از اجزای سلولی خون است که بر حسب نوع سلول خارج شده، عناوین مختلفی به خود می‌گیرد. جداسازی لکوسیت " لکوفرزیس " ، مثلا در هایپرلوکوسیتوزیس ، جداسازی گلبول‌های قرمز " اریتروسیتافرزیس " مثلا در بیماران با سیکل سل انمیا و جداسازی پلاکت‌ها " پلیتلت فرزیس یا " ترومبوسیتافرزیس " نام دارد.

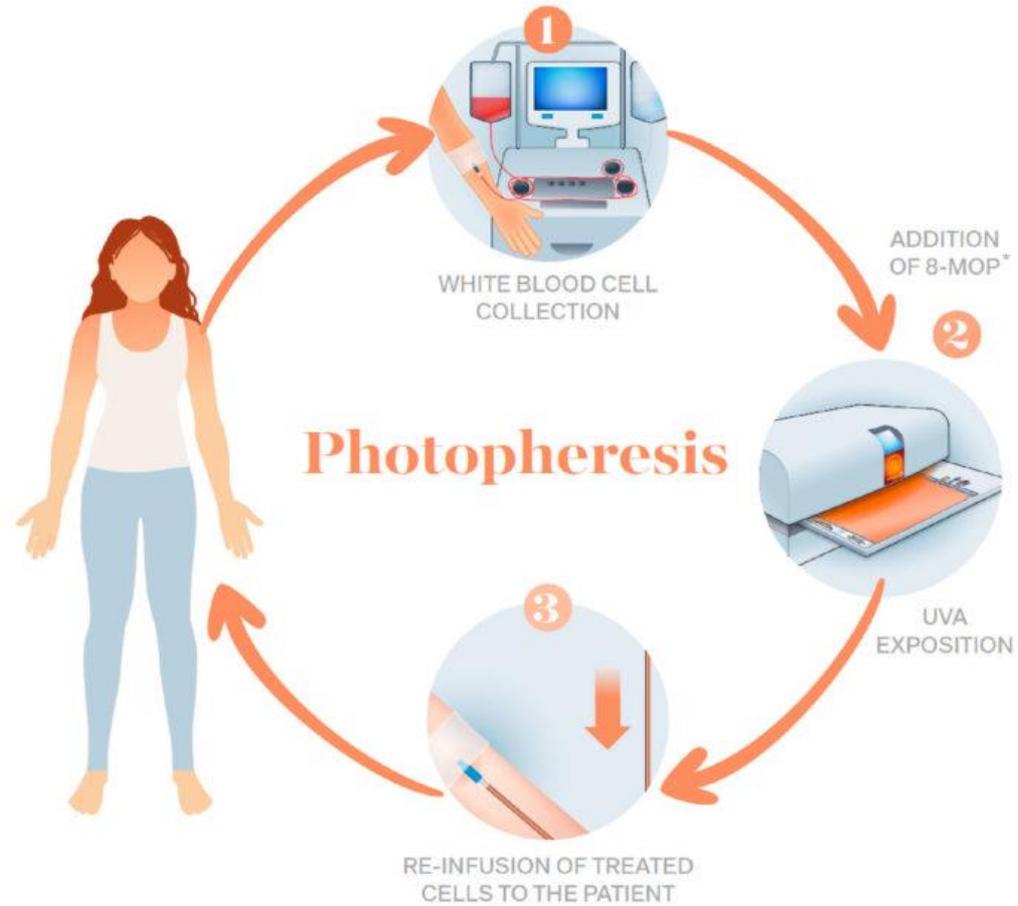
## Separation by centrifugation



- Photopheresis, is a medical treatment that removes blood via a machine and isolates white blood cells. Then, these white cells are exposed to a medication called 8-methoxypsoralen followed by UVA irradiation before returning the blood to the patient. These white cells are targeted because they are underlying cause of disease. In the case of cutaneous T-cell lymphoma, the white cells are abnormal. In other diseases, the white cells are responsible for an immune response which causes transplant rejection or graft versus host disease.

- Photopheresis is used to treat the following medical conditions:
- Lung transplant rejection
- Heart transplant rejection,
- Chronic graft versus host disease (GVHD),  
Cutaneous T-cell lymphoma (CTCL)

# photopheresis



# Care after photopheresis:

- Photopheresis is a safe procedure with a few possible side effects. If intravenous catheters are placed, the arms will be propped on pillows and you will be asked to intermittently pump a fist to help promote blood flow. One may experience bruising or discomfort at the insertion sites. If a larger catheter or port is used, one will have free use of their arms during the procedure. You may experience, nausea, numbness/tingling, or light-headedness. An apheresis staff member specialized with the procedure will be with you throughout the treatment and should be notified of any side effects to help alleviate the symptoms. The procedure typically takes 2 hours.

# patient education

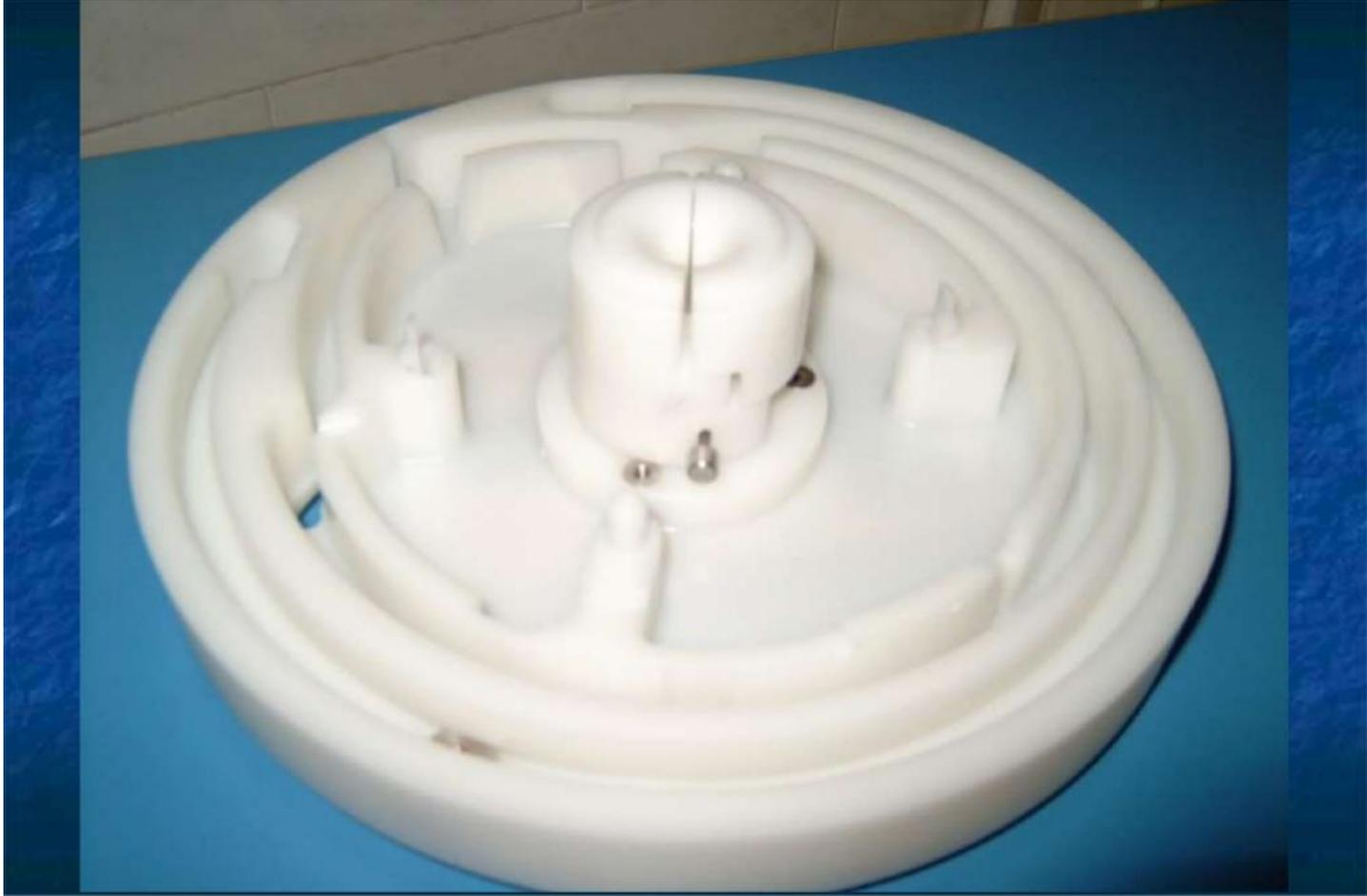
- It is important to avoid direct and indirect sunlight and wear dark glasses for 24 hours after each treatment, as your eyes and skin will be temporarily more sensitive to sunlight.

# **Centrifugation versus membrane filtration**

## **What is centrifugal plasmapheresis?**

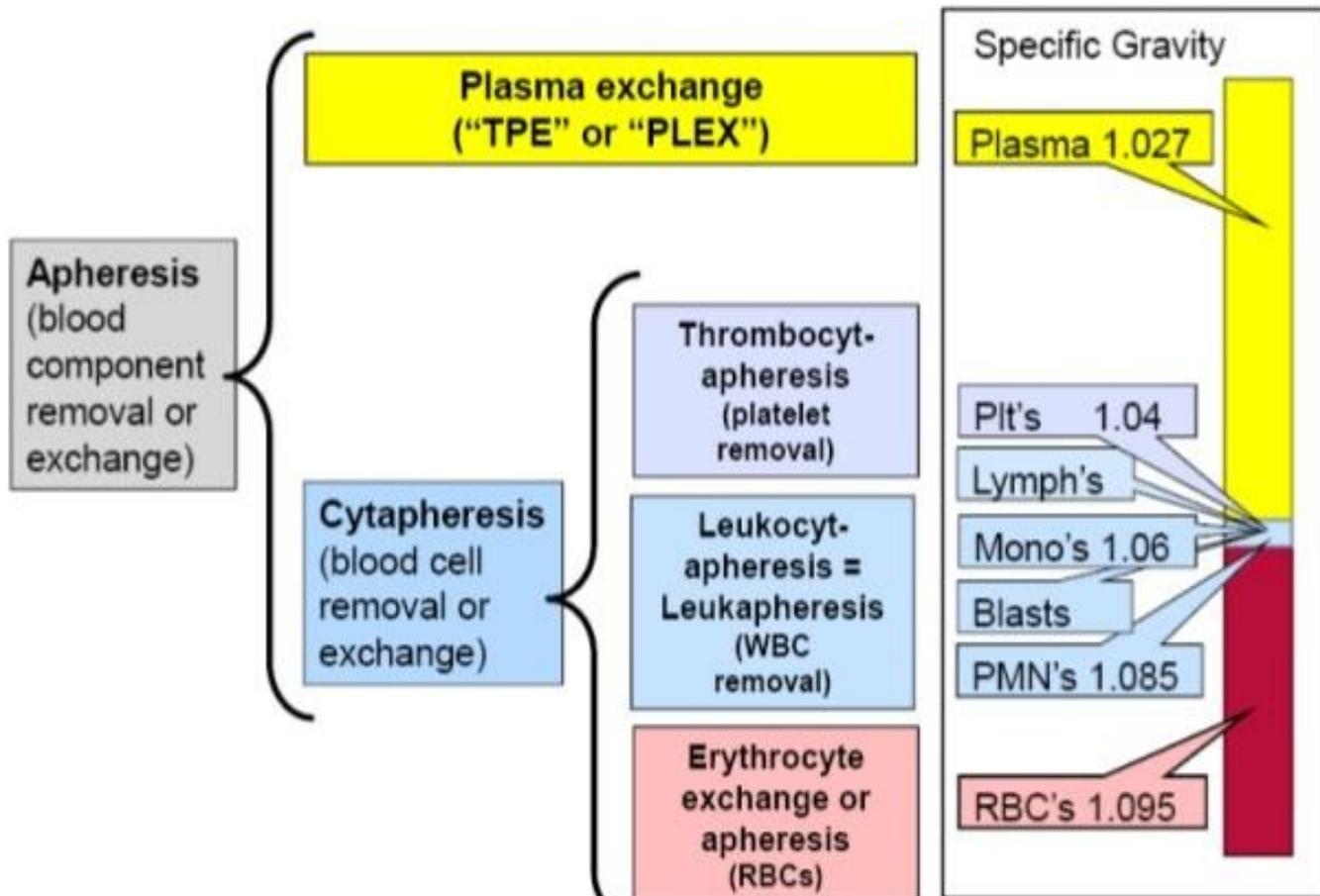
During TPE, whole blood is extracted via the same access points and again centrifuged to separate the plasma from cellular components, the supernatant plasma removed and a replacement fluid mixed with the remaining blood and returned to the patient to prevent hypovolemia.

- The separator is a disposable rotating centrifugal bowl. Blood runs into the bowl and centrifugal force separates blood cells from plasma. Blood cells are pumped back into patient's circulation, whereas plasma is separated in sterile bags.



- The process can occur simultaneously or intermittently. There is no upper limit for the size of the molecules removed by centrifugal PEX. Usually the blood flow ranges between 90 and 150 ml/min. A major disadvantage of centrifugal PEX is platelet count reduction.

## Separation by centrifugation







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# Continuous and intermittent flow centrifugation

Continuous flow centrifugation (CFC) historically required two vein as the "continuous" means the blood is collected, processed, and returned simultaneously. The main advantage of this system is the low extracorporeal volume used in the procedure, which may be advantageous in the elderly and for children

# Intermittent flow centrifugation

Intermittent flow centrifugation works in cycles, taking blood, spinning/processing it and then giving back the unused parts to the donor in a [bolus](#). The main advantage is a single venipuncture site. To stop the blood from [coagulating](#), [anticoagulant](#) is automatically mixed with the blood as it is pumped from the body into the apheresis machine.

# Important considerations:

- The signs and symptoms of citrate toxicity begin with **paresthesia, a "tingling" sensation around the mouth or in the extremities, followed by severe reactions that are characterized by hypotension and possible cardiac arrhythmia.**

# Nursing consideration

- **Pre-Treatment Intervention:** Identifying each patient correctly and obtaining consent.
- Analyzing blood work results.
- Preparing the plasmapheresis machine and needed equipment.
- Clarifying any doctor's orders and taking notice if medications were held prior to the procedure.
- Assessing the patient physically and measuring weight, vital signs (blood pressure, heart rate, temperature, respirations, and oxygen level), level of consciousness, and vascular access; as well as assessing the intravascular and extravascular volume of the patient.

# Intra-Treatment Intervention

- Removing heparin
- Considering vital signs
- Considering CBC and electrolytes
- Monitoring hypotension and reaction to blood product.

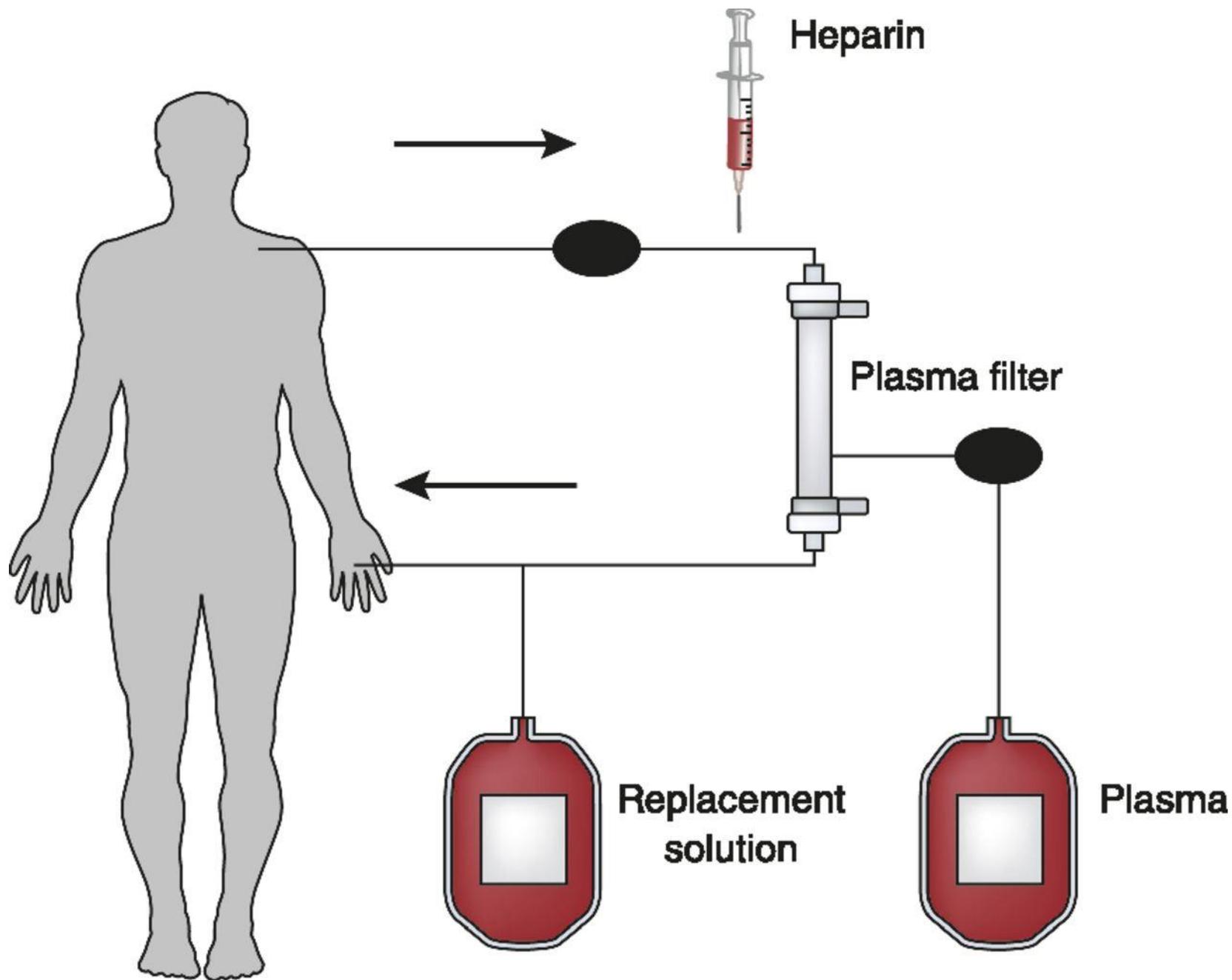
# Post exchange:

- Monitoring vital signs
- Care for access line( washing and heparinized)
- documentation

# Membrane PEX

In this type of PEX, highly permeable hollow fiber membrane filters are used. The fibers have pores with diameter ranging from 0.2 to 0.5  $\mu\text{m}$ . As blood runs through the fibers plasma is separated from the blood cells, which are returned in patient's circulation. All immunoglobulins are effectively cleared by this method

However, its effectiveness is poorer in immune complexes and cryoglobulins. The risk for platelet count reduction is small. Yet, there is a risk for hemolysis, especially if faster blood flow is used (normal values for the method are 90–200 ml/min). Synthetic membranes are used; plasma filters should not be reused



# Comparison between these methods

	Advantages	Disadvantages
<b>Membrane apheresis</b>	<ul style="list-style-type: none"><li>■ Fast and efficient plasmapheresis</li><li>■ No citrate requirements</li><li>■ Can be adapted for cascade filtration</li></ul>	<ul style="list-style-type: none"><li>■ Removal of substances limited by sieving coefficient of membrane</li><li>■ Unable to perform cytappheresis</li><li>■ Requires high blood flows, central venous access</li><li>■ Requires heparin anticoagulation, limiting use in bleeding disorders</li></ul>
<b>Centrifugal devices</b>	<ul style="list-style-type: none"><li>■ Capable of performing cytappheresis</li><li>■ No heparin requirement</li><li>■ More efficient removal of all plasma components</li></ul>	<ul style="list-style-type: none"><li>■ Expensive</li><li>■ Requires citrate anticoagulation</li><li>■ Loss of platelets</li></ul>

The above mentioned plasma separation techniques remove plasma from whole blood, thus causing loss of normal proteins, especially coagulation factors and albumin. In order to reduce protein loss, selective PEX techniques were introduced into practice.

# Double cascade PEX

Cascade filtration is a semi-selective separation technique, in which after initial separation of plasma from blood cells, additional filtration of plasma is performed with different diameters of fiber pores, so that target protein fractions are filtered and the rest are pumped back in circulation. This technique showed up to 70% reduction in albumin loss after the procedure

# Cryofiltration

The method is used to remove cryoglobulins in several immune diseases. After plasma is initially filtrated, it is cooled to 4°C. This causes precipitation of cryoglobulins and they do not pass the second membrane. Afterwards, the cooled plasma is warmed to body temperature again and is returned to the patient.

# Thermofiltration

Similar to cryofiltration, plasma is firstly separated from whole blood. Before the selective filtration, the filtrate is warmed up to 40°C, causing aggregation of VLDL and LDL molecules. Then second filtration is performed and the filtrate is introduced back into patient's blood. The method is not widely used due to the fact that little is known about the changes in large molecules after being exposed to higher temperatures

# Unselective adsorption

Unselective adsorption uses charcoal or ion exchange resins to remove exogenous or endogenous toxins from blood (hemoperfusion) or from filtered plasma (plasmapheresis). These methods are most commonly indicated in exogenous intoxications. There are reports that hemoperfusion was effective in sepsis, septic shock and disseminated intravascular coagulation.

- In hemoperfusion, the blood perfuses a filter composed of artificial cells filled with activated carbon or another microporous material. Small molecules in solution within the serum (such as the toxin) cross the membranes into the microporous material (and get trapped therein), but formed elements (the blood cells) brush past the artificial cells just as they brush past each other. In this way, the microporous material's filtering ability can be used without destroying the blood cells.

- Complications of hemoperfusion may include **thrombocytopenia, leucopenia, hypoglycemia, and some reduction in clotting factors**, with recovery typically occurring in 1–2 days. Risk of bleeding is also higher because of the high heparin dose and reduction in platelets and clotting factors.

# Selective adsorption or immunoadsorption

In selective adsorption the initial filtrate runs through prearranged immunosorbents. Thus, specific antibodies can be selectively removed, whereas albumin and clotting factors are returned to the patient.

- Immunoabsorption is the further development of plasma exchange by which plasma is first removed and then passed over columns with specific ligands (for example Protein A) to remove specifically immunoglobulins. (From: [Handbook of Clinical Neurology, 2013](#))
- Advantageously, immunoabsorption does not remove other plasma components such as fibrinogen, and compounds of the coagulation cascade, which reduces adverse effects.



از توجه شما سپاسگزارم