

PLASMA VOLUME EXPANDERS

These are high molecular weight substances which exert colloidal osmotic (oncotic) pressure, and when infused i.v. retain fluid in the vascular compartment. They are used to correct hypovolemia due to loss of plasma/blood.

Human plasma or reconstituted human albumin would seem to be the best. However, the former carries risk of transmitting serum hepatitis, AIDS, etc., and the latter is expensive. Therefore, synthetic colloids are more often used. The desirable properties of a plasma expander are given in the box.

Desirable properties of plasma expander:

1. Should exert oncotic pressure comparable to plasma.
2. Should remain in circulation and not leak out in tissues, or be too rapidly disposed.
3. Should be pharmacodynamically inert.
4. Should not be pyrogenic or antigenic.
5. Should not interfere with grouping and cross matching of blood.
6. Should be stable, easily sterilizable and cheap.

Substances employed are:

Human Albumin

Dextran

Polygeline

Hetastarch

Human albumin: It is obtained from pooled human plasma; 100 ml of 20% human albumin solution is the osmotic equivalent of about 400 ml of fresh frozen plasma or 800 ml of whole blood. It can be used without regard to patient's blood group and does not interfere with coagulation. Unlike whole blood or plasma, it is

free of risk of transmitting serum hepatitis because the preparation is heat treated. There is also no risk of sensitization with repeated infusions.

The 20% solution draws and holds additional fluid from tissues: crystalloid solutions must be infused concurrently for optimum benefit. Apart from burns, hypovolemia, shock, etc., it has been used in acute hypoproteinaemia, acute liver failure and dialysis. Dilution of blood using albumin and crystalloid solutions can be used before cardiopulmonary bypass. Febrile reaction to human albumin occurs occasionally. It is expensive.

Dextran: It is a polysaccharide obtained from sugar beat, and is available in two forms.

Dextran-70 (MW 70,000)

Dextran-40 (MW 40,000; low MW dextran)

The more commonly used preparation is dextran-70. It expands plasma volume for nearly 24 hours, and is slowly excreted by glomerular filtration as well as oxidized in the body over weeks. Some amount is deposited in RE cells. Dextran has nearly all the properties of an ideal plasma expander except:

- (a) It may interfere with blood grouping and cross-matching.
- (b) Though the dextran used clinically is not antigenic, its structure is similar to other antigenic polysaccharides. Some polysaccharide reacting antibodies, if present, may cross react with dextran and trigger anaphylactic reaction. Urticaria, itching, bronchospasm, fall in BP occur occasionally; anaphylactic shock is rare.
- (c) It can interfere with coagulation and platelet function, and thus prolong bleeding time; should not be used in hypofibrinogenaemia, thrombocytopenia or in presence of bleeding.

Polygeline (Degraded gelatin polymer): It is a polypeptide with average MW 30,000 which exerts oncotic pressure similar to albumin and is not antigenic; hypersensitivity reactions are rare, but should be watched for. It does not interfere

with grouping and cross-matching of blood and remains stable for three years. It is not metabolized in the body; excreted slowly by the kidney. Expansion of plasma volume lasts for 12 hours. It is more expensive than dextran. It can also be used for priming of heart-lung and dialysis machines.

Hypersensitivity reactions like flushing, rigor, urticaria, wheezing and hypotension can occur.

Hetastarch: It is a complex mixture of ethoxylated amylopectin of various molecular sizes; average MW 4.5 lac (range 10,000 to 1 million). The colloidal properties of 6% hetastarch approximate those of human albumin. Plasma volume expands slightly in excess of the volume infused. Haemodynamic status is improved for 24 hour or more. Hetastarch is incompatible with many drugs; no injectable drug should be added to the infusion. Blood grouping and cross matching may be vitiated.

Smaller molecules (MW < 50,000) are excreted rapidly by kidney; 40% of infused dose appears in urine in 24 hr. Larger molecules are slowly broken down to smaller ones and eliminated with a $t_{1/2}$ of 17 days.

Adverse effects: are vomiting, mild fever, itching, chills, flu like symptoms, swelling of salivary glands. Urticaria, periorbital edema and bronchospasm are the anaphylactoid reactions.

USE OF PLASMA EXPANDERS:

These colloidal solutions are used primarily as substitutes for plasma in conditions where plasma has been lost or has moved to extravascular compartment, e.g. in burns (acute phase only), hypovolemic and endotoxin shock, severe trauma and extensive tissue damage. They can also be used as a temporary measure in cases of whole blood loss till the same can be arranged: but they do not have O₂ carrying capacity. Apart from albumin, other plasma expanders should not be used for

maintenance of plasma volume in conditions like burns, where proteins leak out with fluids for several days.