

Essential of Blood Component Therapy

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Definition

- *Blood component*: A blood component is a portion of blood which is separable by physical or mechanical means, such as differential centrifugation
- *Blood fractions*: It is a derivative of plasma obtained by chemical processes, e.g. alcohol precipitation.
- *Blood products*=blood components +Plasma fractions

Requirements for component preparation

- Blood donor
- Hardware
- Plastic bag
- Temperature
- Mechanical/ 'g' force
- Specific gravity of blood component
- Good manufacturing practice
- Safe transfusion practice

Blood donor selection

- All units collected by D&C act criteria.
- Criteria for whole blood collection:
 - *collected within 8-10 min.
 - *processed within 6-8 hours
 - *constantly mixing, 450 \pm 10 ml
 - *no aspirin within 48 hours
 - *QC in collection (weight monitor)

Blood donor selection (*cont...*)

- Type of donors (paid, professional, captive, relative, fringe motivated VD, altruistic VD, autologous, directed, apheresis).
- Donor selection for apheresis: consent, duration, TTD testing, RBC loss/ product cross match, Multiple product collection

Hardware

- Refrigerated centrifuge (inductn. motor)
- Deep freeze (-30° & -80° C; double door/ horizontal)
- Blast freezer
- Refrigerated water bath.
- Platelet shaker/ incubator
- Plasma expresser, sealer, balance, Wt.
- Cell separator machine.

Plastic bags

- Closed system.
- Double, triple, quadruple, top-bottom.
- Plastics (DEHP, butyldehyde, leaching)
- O₂ permeation (platelet 3-5 days).
- Extreme of temp. (-196° to +37° C).
- Withstand high centrifugal force.

Temperature

- -196°C =For RBC, Platelet, stem cell
- -80 to -30°C =For FFP, Cryoppt., CPP.
- $+ 4^{\circ}\text{C}$ =For RBC liquid preservation
- $+ 22^{\circ}\text{C}$ =For platelet preservation.
- $+ 37^{\circ}\text{C}$ =Transfusion of component
- $+ 60^{\circ}\text{C}$ =Dry heat viral inactivation
- $+160^{\circ}\text{C}$ =Dry heat sterilization.
- $+1200^{\circ}\text{C}$ =Plasma incineration.

Mechanical ('g') force

- Gravitational force:
 - *Overnight hanging.
- Mechanical force
 - *Refrigerated centrifuge (induction motor)
 - *Cell separator (intermittent/ continuous)

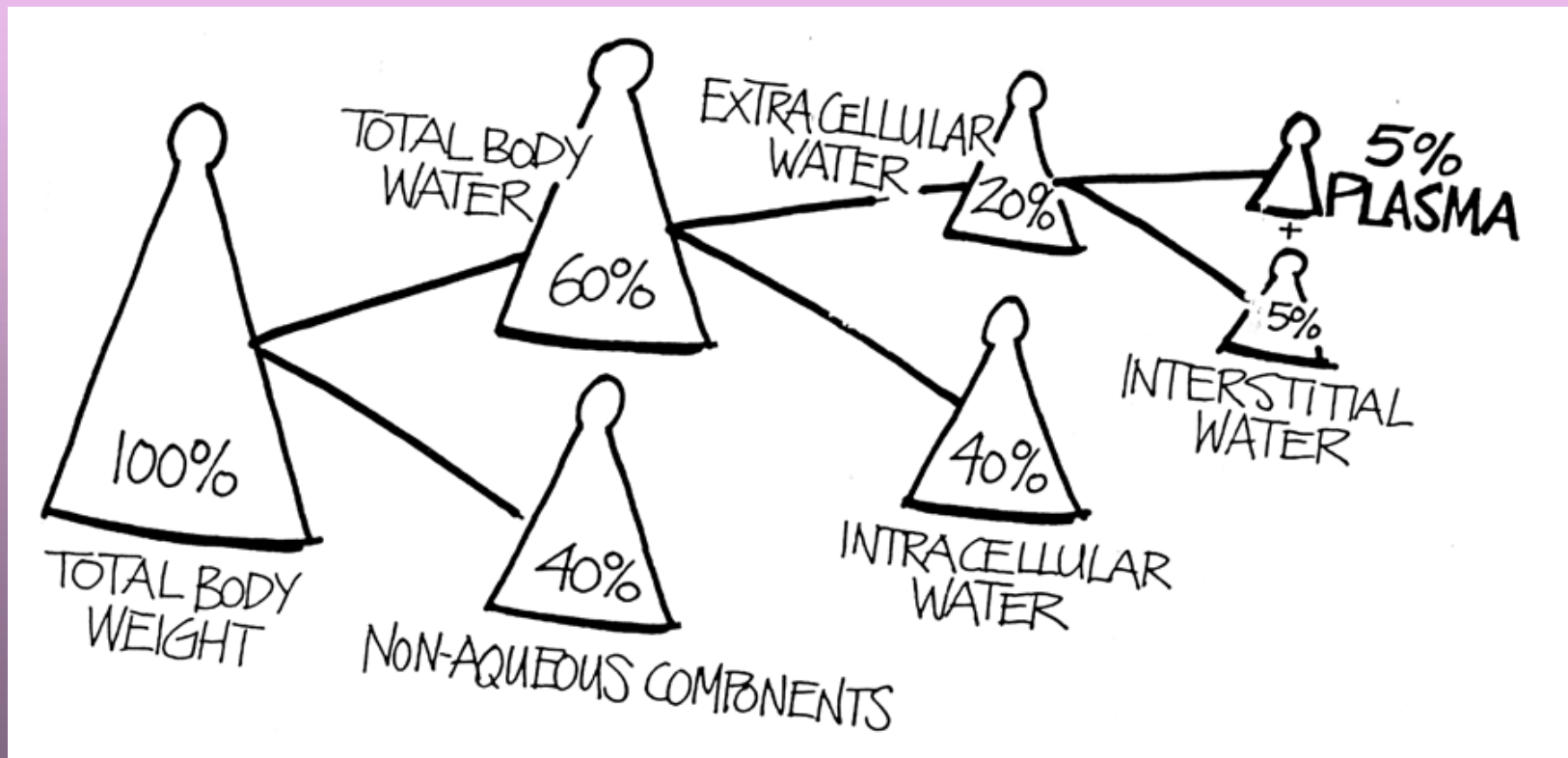
Mean density of blood components

- Plasma : 1.026
- Platelet : 1.058
- Monocyte : 1.062
- Lymphocyte : 1.070
- Neutrophil : 1.082
- Red cells : 1.100

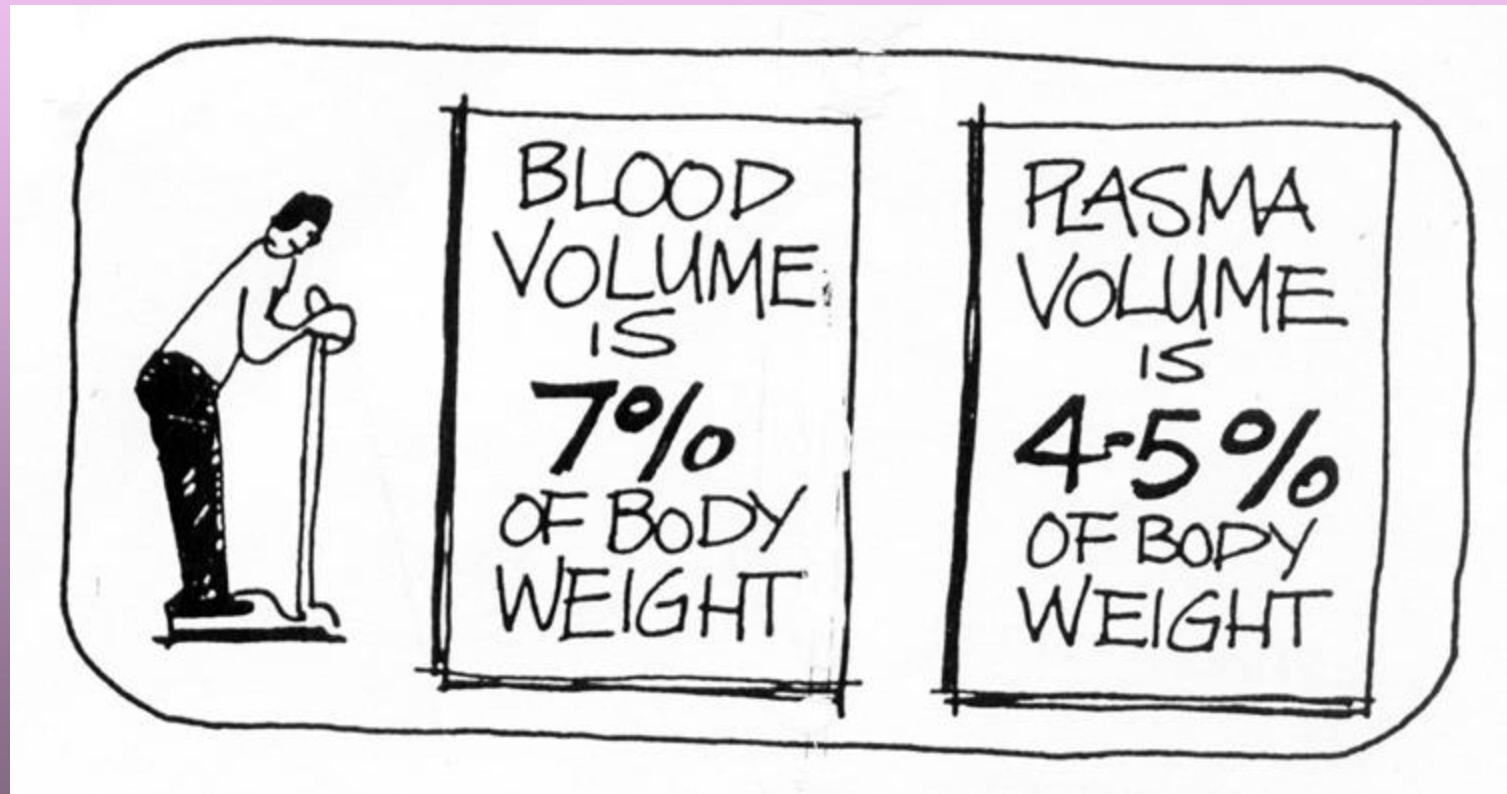
Blood components

Blood components	Plasma derivates
<p data-bbox="177 388 765 436"><u>O₂ carrying components</u></p> <ul data-bbox="177 454 749 634" style="list-style-type: none"><li data-bbox="177 454 537 496">• Red blood cells<li data-bbox="177 522 571 565">• Leukopoor blood<li data-bbox="177 591 749 634">• Frozen thawed red blood <p data-bbox="177 728 595 776"><u>Platelet products</u></p> <ul data-bbox="177 793 753 911" style="list-style-type: none"><li data-bbox="177 793 753 836">• Platelet rich plasma(PRP)<li data-bbox="177 862 749 905">• Platelet concentrate (PC) <p data-bbox="177 1005 560 1053"><u>Plasma product</u></p> <ul data-bbox="177 1071 776 1319" style="list-style-type: none"><li data-bbox="177 1071 776 1113">• Fresh frozen plasma (FFP)<li data-bbox="177 1139 525 1182">• Frozen plasma<li data-bbox="177 1208 537 1250">• Cryoprecipitate<li data-bbox="177 1276 653 1319">• Stored liquid plasma	<p data-bbox="1016 388 1607 436"><u>Coagulation factor conc.</u></p> <ul data-bbox="1016 454 1553 568" style="list-style-type: none"><li data-bbox="1016 454 1406 496">• Factor VIII conc.<li data-bbox="1016 522 1553 565">• Factor IX complex conc <p data-bbox="1016 662 1356 711"><u>Oncotic agent</u></p> <ul data-bbox="1016 728 1642 842" style="list-style-type: none"><li data-bbox="1016 728 1224 771">• Albumin<li data-bbox="1016 796 1642 839">• Plasma protein fraction:PPF <p data-bbox="1016 933 1599 982"><u>Immune serum globulin</u></p> <ul data-bbox="1016 999 1657 1248" style="list-style-type: none"><li data-bbox="1016 999 1657 1042">• Hepatitis B immune-globulin<li data-bbox="1016 1068 1483 1110">• Rh immune-globulin<li data-bbox="1016 1136 1452 1179">• Varicella-Zoster Ig.<li data-bbox="1016 1205 1591 1248">• Tetanus immune globulin

Plasma & body weight



Blood volume



Blood components that carry O₂

Red blood cell suspension	Other products capable of carrying O ₂
<ul style="list-style-type: none">•Red blood cells•Leukocyte poor blood•Frozen thawed RBC•Irradiated RBC•Washed RBC	<ul style="list-style-type: none">•Perflourochemical•Modified hemoglobin

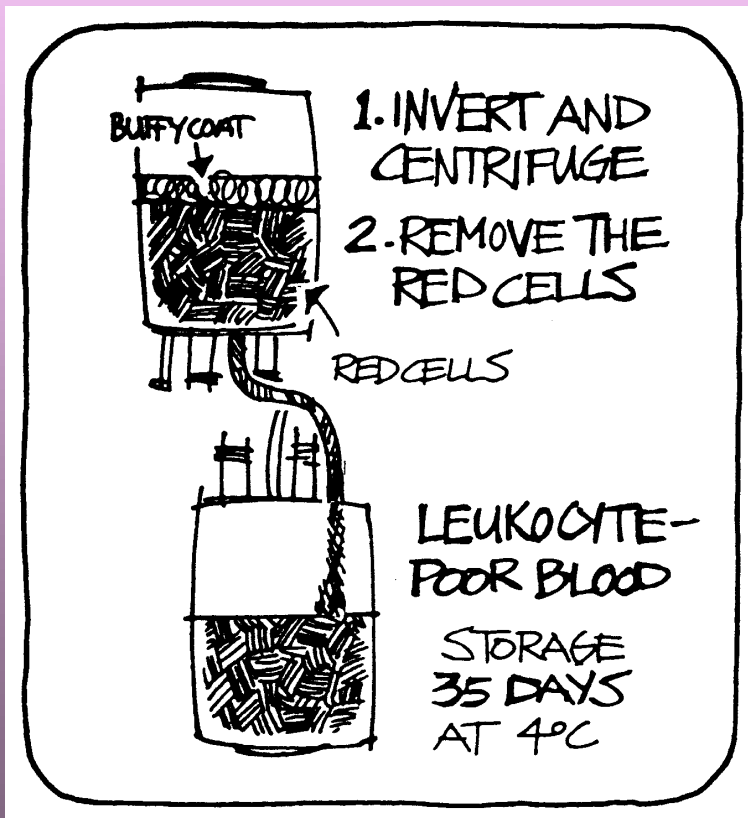
Red blood cells

- Source: by product.
- Preparation: Hard/ light centrifugation
- Shelf life: 35 (CPDA₁) & 45 (SAGM) days
- Preservation: +4°C
- Indication: to increase O₂ carrying capacity
- Contraindication: None.

Leukocyte-poor RBC.

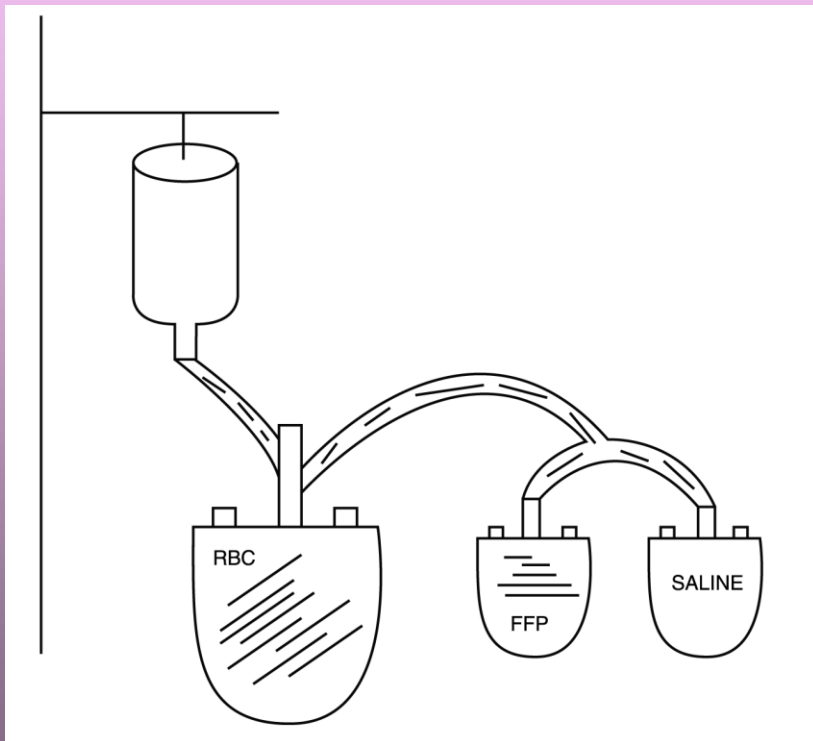
- Source: pre-storage or bed-side.
- Preparation: Inverted centrifugation, Washed RBC, Sedimentation, Deglycerolized RBC, Automated blood component extractor, Filtration.
- WBC reduction:80-99.9%
- Indication: NHFTR prevention, leukocyte immunization, CMV transmission.

Inverted centrifugation



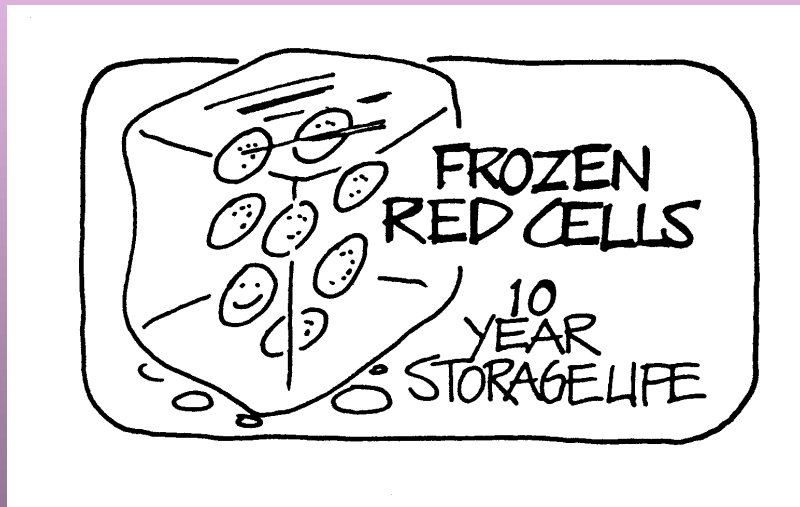
- Blood units centrifuged inverted.
- *Use:* to prevent FNHTR
- *Adv:* Simple technique, no extra equipment.
- *Disadv:* poor leuko-depletion, no accuracy, viscosity.

Saline washed RBC



- NaCl added, centrifuged, resuspended in NaCl.
- *Use*: FNHTR, allergic Tx reaction, IgA deficiency
- *Adv*: Simple tech, low viscosity.
- *Disadv*: Open system, poor leukodepletion.

Frozen deglycerolized RBC



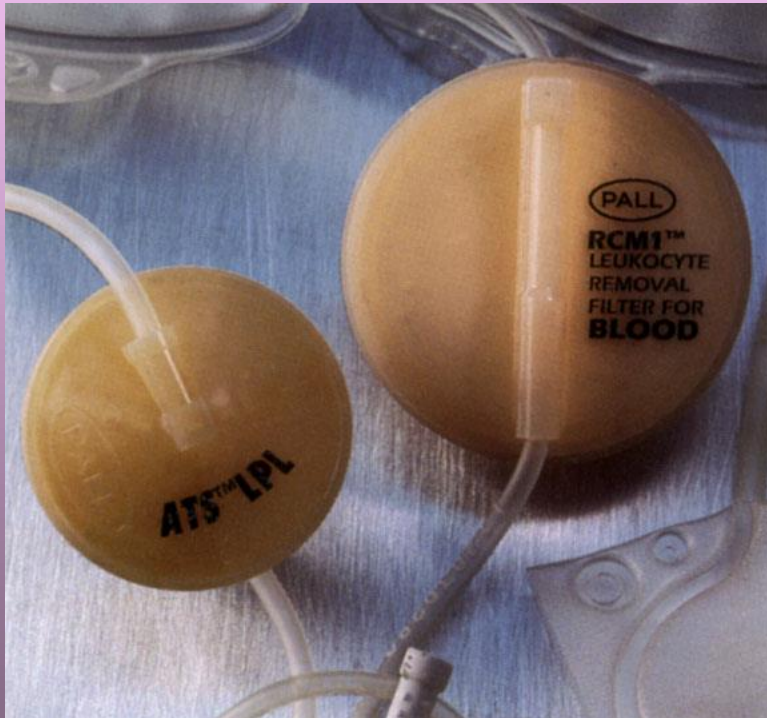
- RBC is frozen in glycerol washed & resuspend in NaCl before Tx.
- Use: Rare blood group, autologous Tx, multiple allo-antibody.
- Adv: storage 10 yrs, rare situations.
- Disadv: Special tech, open system.

Automated blood component extractor



- Blood collected in quad bags, LD by buffycoat/ PRP method, 1 log reduction.
- Use: FNHTR, prevents alloimmunization.
- Adv: High yield, no RBC contamination, 3 min operation (12 sensors), automated, data transfer

Leukocyte filters



- Pre-storage (better for QC)/ bed side filtran; web & pores retain WBC (99.9%)
- QC: 5×10^6 WBC in all units tested.
- Adv: Immunization preventn, FNHTR, CMV transmission.
- Disadv: cost.

Platelet concentrate

- Source: Random donor & Apheresis.
- Preparation:
 - *Random donor= PRP & buffy coat
 - *Apheresis=intermittent or continuous type machine.
- Increment: RDP= 5.5×10^{10} , SDP= 3×10^{11}
- Temp: 22° C, pH: 6.0 to 7.4.
- Indications: Decreased production, severe bleeding, DIC, Plt. alloimmunization.

Thrombocytopenia & probable risk of bleeding

Platelet count (per cmm)	Risk of bleeding
$<5 \times 10^3$	Life threatening bleeding is a possibility.
$5-20 \times 10^3$	Increased likelihood of spontaneous bleeding.
$20-50 \times 10^3$	Increased likelihood of bleeding in trauma, surgery, gast. ulcer etc
$>50 \times 10^3$	Bleeding rarely occurs

Fresh frozen plasma

- Source: Whole blood within 6-8 hours.
- Preparation:
 - *By centrifugation or by apheresis.
 - *Blast/ flat/ ethanol bath freezing.
- Temp: -30° C for 1 year.
- Indication: Patient requiring coagulation factors.

Coagulation factors available per unit of FFP

Factors	Average levels/ unit of FFP
• Fibrinogen	2.41 Gm.
• Factor II	1.03 u/ml
• Factor V	0.64 u/ml
• Factor VII	1.21 u/ml
• Factor VIII	0.85 u/ml
• Factor IX	0.91 u/ml
• Factor X	1.25 u/ml
• Factor XI	0.79 u/ml
• Antithrombin III	104%

Clinical indications of FFP

Definite indication	Conditional uses	No justification
<ul style="list-style-type: none">• Replacement of F.deficiency• Reversal of Warfarin action• Vit.K deficiency with bleeding• Acute DIC• TTP• Inherited Coagulatn. Deficiency	<ul style="list-style-type: none">• Massive transfusion• Liver disease• Cardiopulmonary by-pass surgery	<ul style="list-style-type: none">• Hypovolaemia• Plasma exchange• Nutritional support & protein loosing state

Cryoprecipitated AHF

- It is the insoluble part of the FFP after thawing.
- Rich in F.VIII, fibrinogen, Ig & others.
- Storage at -40° C. for 1 year.
- About 15 ml contains about 80-120 IU of F.VIII, no group specificity.
- Indication: To replace F.VIII, fibrinogen

Use of components in various indications

Deficiency	Blood product indicated
<ul style="list-style-type: none">• Fibrinogen• Factor V• Factor VII• Factor VIII• Factor vW• Factor IX• Factor X• Factor XI• Factor XIII	<p>Cryoppt., stored plasma</p> <p>FFP, Frozen plasma</p> <p>Factor IX complex conc., stored plasma</p> <p>Factor VIII conc., cryoppt.</p> <p>Cryoppt., FFP.</p> <p>Factor IX concentrate.</p> <p>Stored plasma.</p> <p>Stored plasma.</p> <p>Stored plasma.</p>

Single donor plasma

- Source: After cryoppt. removal, outdated FFP, 5 days after WB expiry.
- Preparation: Hard spin & cryoppt. Removal; Thawed FFP; Hard spin & remove plasma from expired WB.
- Shelf life: 5 years at -20° C.
- Indication: Protein (vol?) replacement.

Blood irradiation & TA-GvHD

- Implicated blood components:
 - * Whole blood/ RBC/ Filtered RBC.
 - * Fresh plasma.
 - * Platelets.
 - * RBC & Platelets treated with 15-20 Gy.
 - * Leukocyte form healthy donors.
- Blood components not implicated:
 - * Fresh frozen plasma.
 - * Frozen deglycerolized RBC.
 - * Clotting factor concentrate.

Indications for Irradiated Blood

- Absolute indications:
BMT, biological relatives, I.U.Tx., Cong. immune deficiency, granulocyte Tx.
- Relative indications:
Premature infant, NHL, Solid organ (non kidney) transplant, Nonhem malignancies
- Controversial use:
Pregnancy, aplastics, HLA matched Tx, general onco & surg. Patients, neonates.

Fibrin-glue



- Source: Cryoppt. & thrombin (human/bovine).
- Preparation: Liquid cryoppt. & thrombin is applied on surface
- Shelf life: Two years
- Indications: suturing, raw surface, epithelial bleeding

Good manufacturing practice

- “Do what is written, write down what you do”.
- SOP in all Labs, revision 6 monthly, signed & authorized by comp. Authority
- QA: 1% of total units, 75% product to conform with standard, monthly audit.
- EQAS:Local, regional, NACO, WHO.

Safe transfusion practice

- Developing guideline for rational use of blood (guidelines to real users).
- Clinician awareness & training sessions
- Transfusion with definite indications.
- Setting up hospital transfusion committee.
- Ensuring availability of blood/ components
- Promoting blood component therapy.
- Managing inventory of blood & component.