

# Autotransfusion and More

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# Autotransfusion

Autotransfusion is the collection of blood or blood products derived from a patient's own circulation (autologous blood) which is collected or shed from a wound or body cavity prior to, during or following surgery for later reinfusion to the patient

# Why Autotransfusion?

- Reduced supply of allogeneic blood
- Reduces risk of infection
- Negates the risk of the immune phenomenon
- Religious considerations

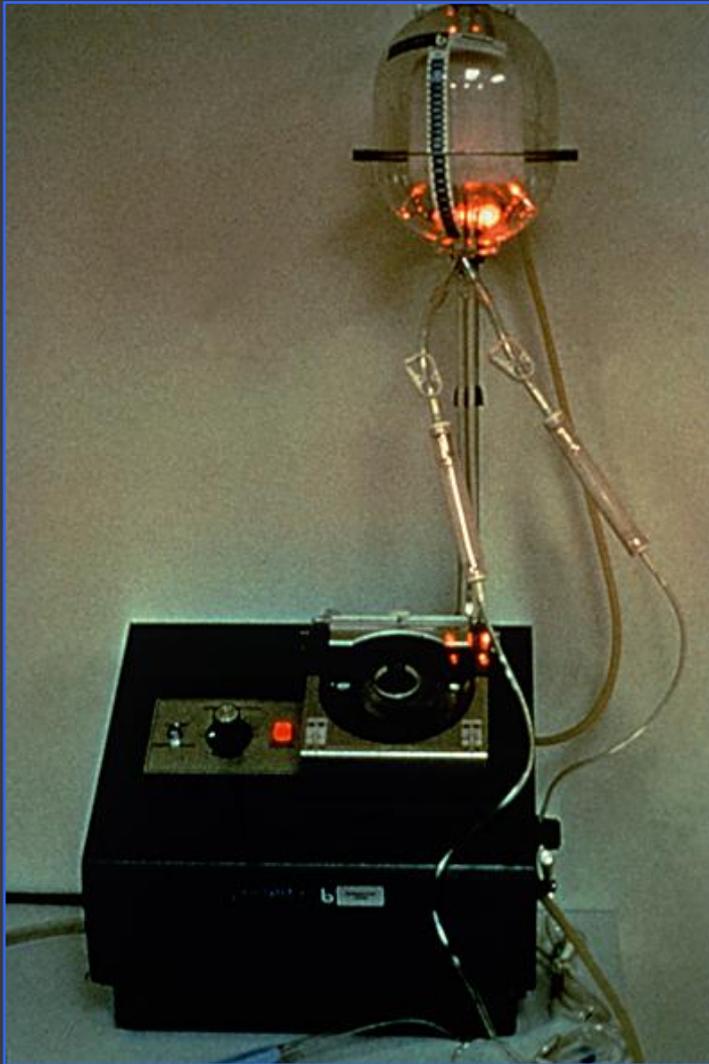
# Why Autotransfusion?

- Immediate availability
- Conserves allogeneic blood for real emergencies
- Eliminates blood bank clerical errors
- Is truly cost effective

# Autotransfusion Triggers

- ⦿ Anticipated blood loss is equal to or greater than 1000 ml
- ⦿ Procedures where 2 units of blood are routinely cross matched
- ⦿ Procedures where 20% of the patients are routinely transfused
- ⦿ Emergency procedures
- ⦿ Patients with rare blood types or incompatibilities
- ⦿ Patients with religious objections to allogeneic blood components

# History of Autotransfusion

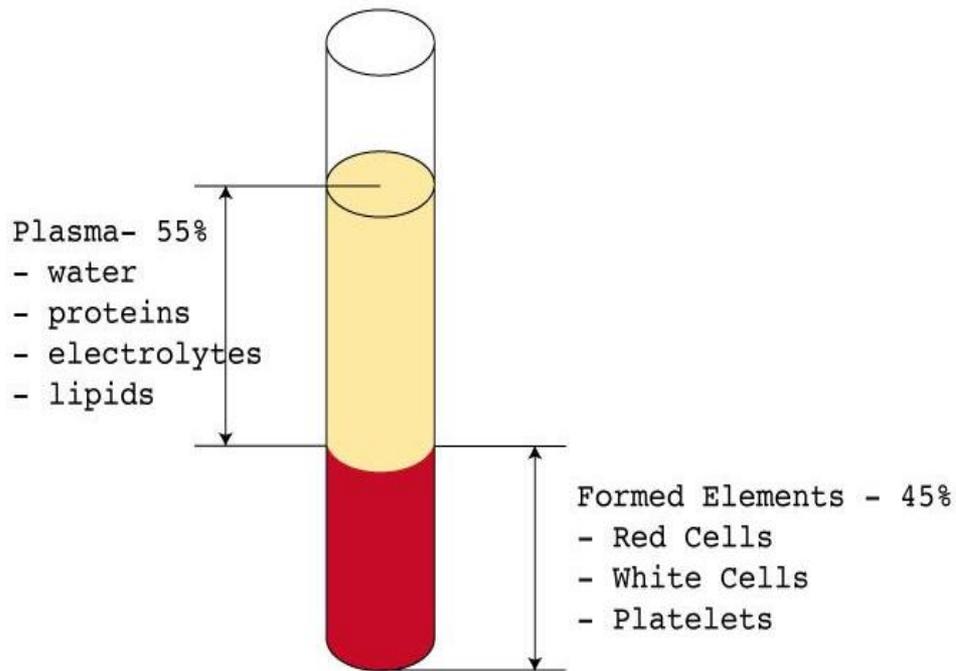


- ◎ 1970's: Dr. Klebenoff developed an autotransfusion system, ultimately marketed by Bentley. Air embolism and disseminated intravascular coagulation (DIC) events led to its removal from the U.S. market.

# AUTOTRANSFUSION

General Principles

# Blood Components



- Plasma
  - Water
  - Proteins
  - Electrolytes
  - Lipids
- Formed Elements
  - RBC
  - White Cells
  - Platelets

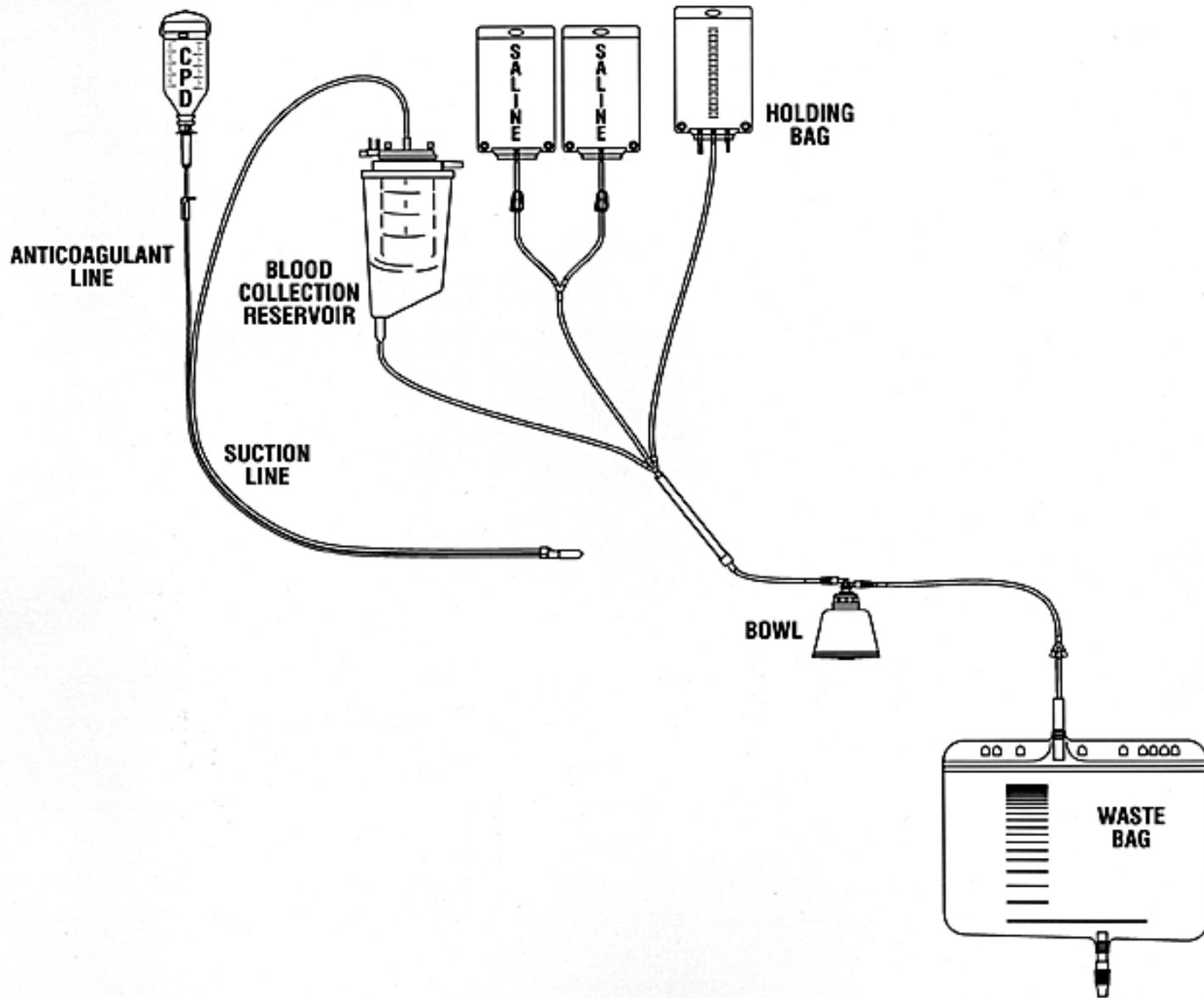
# Principles of Autotransfusion

## ⦿ Density of Blood Components:

- Plasma 1.025 - 1.029 gm/cc
- Leukocytes 1.065 - 1.09 gm/cc
- Erythrocytes 1.089 - 1.097 gm/cc

# Principles of Autotransfusion

Centrifugal force separates these components relative to their respective densities. The higher density components will move farther from the axis of rotation than those of lower density.



# Autotransfusion System Components

- Suction tip
- Suction/Anticoagulant line
- Anticoagulant solution
- Filtered Collection Reservoir
- Centrifuge bowl and disposable tubing set (tubing, bowl, holding bag and waste bag)
- Saline wash solution bags – 500 and 1000 ml
- Blood transfer bags

# Principles of Autotransfusion

- ⦿ Before commencing to salvage blood:
  - Prime autotransfusion circuit with 100 - 200 ml of anticoagulant solution
    - 30,000 units of heparin per 1000 ml 0.9% Normal saline or citrate based anticoagulant (ACD-A)
    - Anticoagulation ratio is 15 ml of anticoagulant per 100 ml blood collected
  - Suction should be maintained at approximately 80 - 150 mm/Hg. (No more than 200 mm/Hg is recommended under normal circumstances and minimize aspirated air)

# Anticoagulation

- ⦿ Heparinized saline - 30,000 units of heparin per 1000 ml 0.9% Normal saline or 15,000 units of heparin per 500 ml Normal saline
- ⦿ Heparin complexes with Antithrombin III (ATIII)
- ⦿ Heparin should not be used on ATIII deficient patients or patients prone to Heparin Induced Thrombocytopenia (HIT)
- ⦿ ACD-A inhibits the early steps in the clotting cascade by chelating (binding) Calcium
- ⦿ Do not use ACD-A on patients with impaired liver function
- ⦿ ACD-A comes pre-mixed in 500 ml bags
- ⦿ Do not aspirate blood mixed with Ringers Lactate irrigation solutions when using citrate based anticoagulants

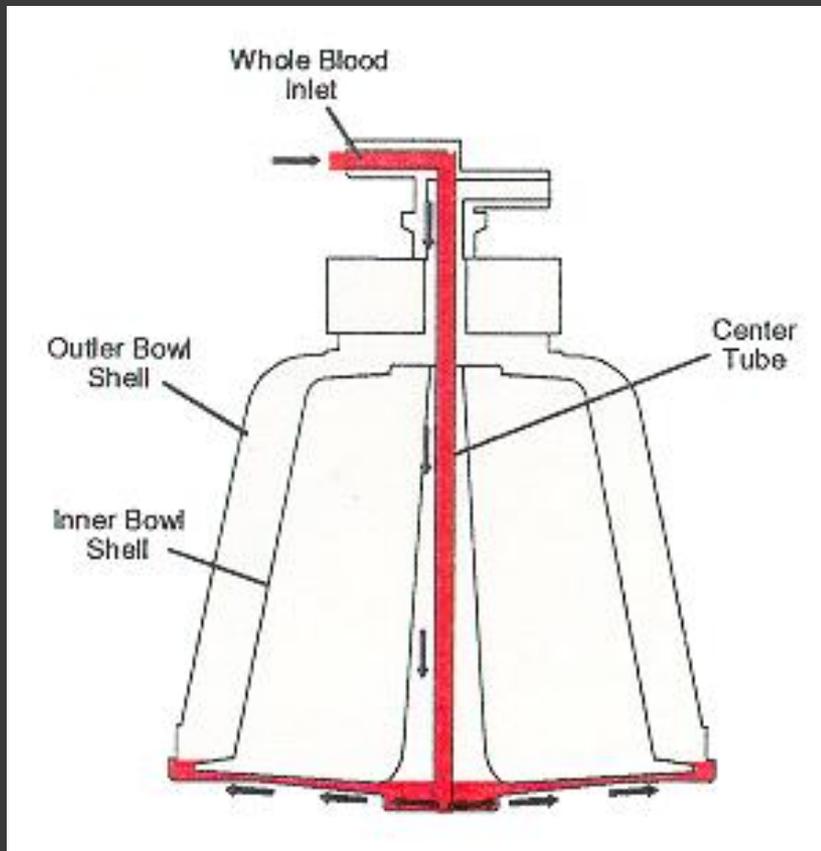
# Principles of Autotransfusion

- ⦿ Whenever you empty the reservoir always re-prime it with at least 100 ml of anticoagulant solution
- ⦿ During collection keep the anticoagulant running at 13 -15 ml per 100 ml of collected blood (1 part anticoagulant to 7 parts blood)
- ⦿ Same anticoagulant ratio for post operative salvage

# Principles of Autotransfusion with Latham and Baylor Bowl Devices

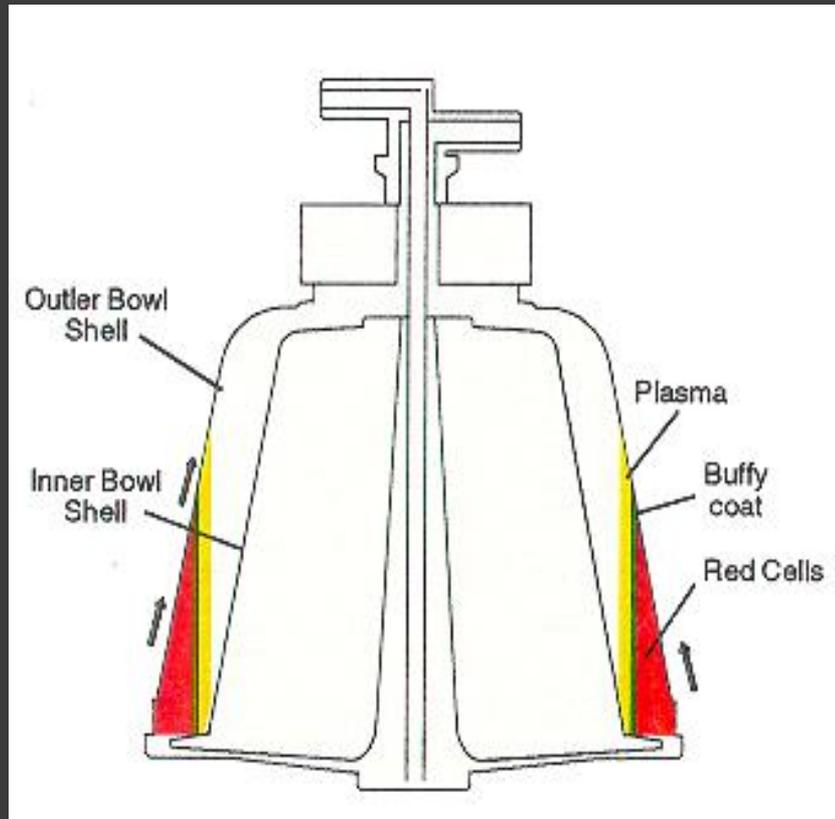
- Once sufficient volume has been collected in the blood collection reservoir, select FILL on the device to commence filling the bowl/separation container with blood
- When the red blood cells approach the middle of the bowl shoulder on the 225 or 250 ml bowl, the level sensor will detect a full bowl
- Use the appropriate WASH program based upon the need or urgency to return fluid volume to the patient

# Latham Bowl Processing



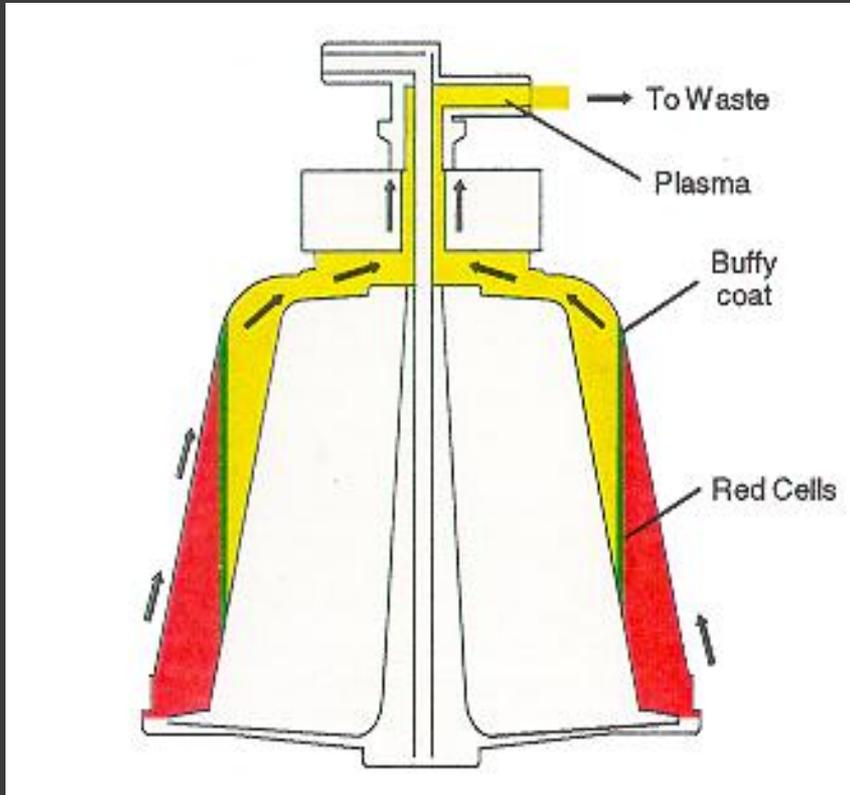
- Blood Enters inlet port
- Travels down the fill straw
- Centrifugation caused the blood to move to the edge of the bowl

# Latham Bowl Processing



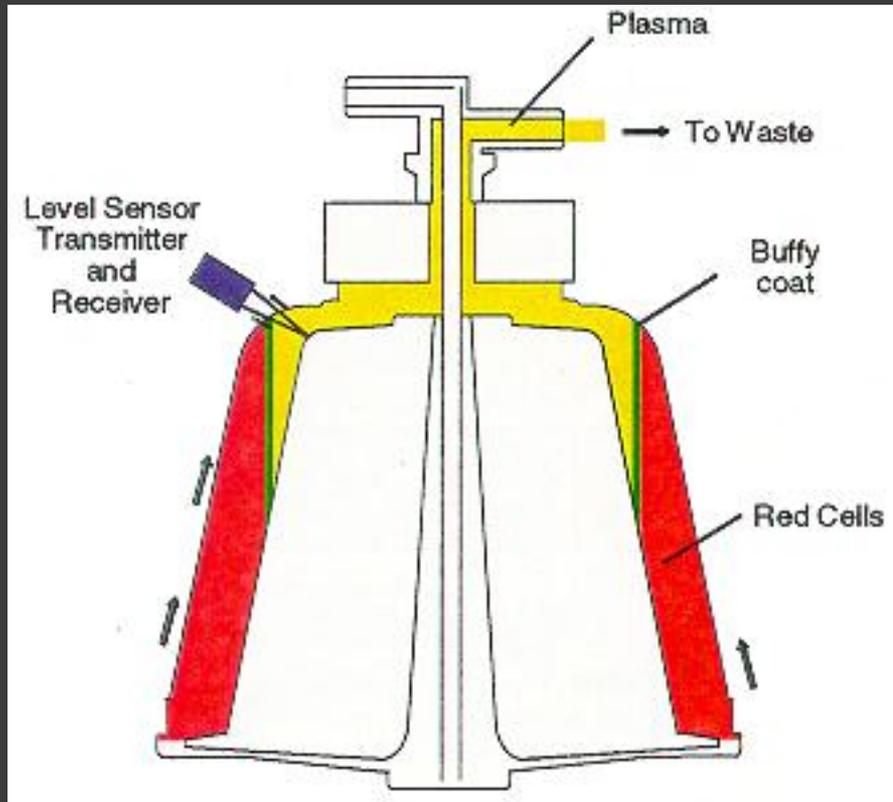
- Blood components separate vertically according to density

# Latham Bowl Processing



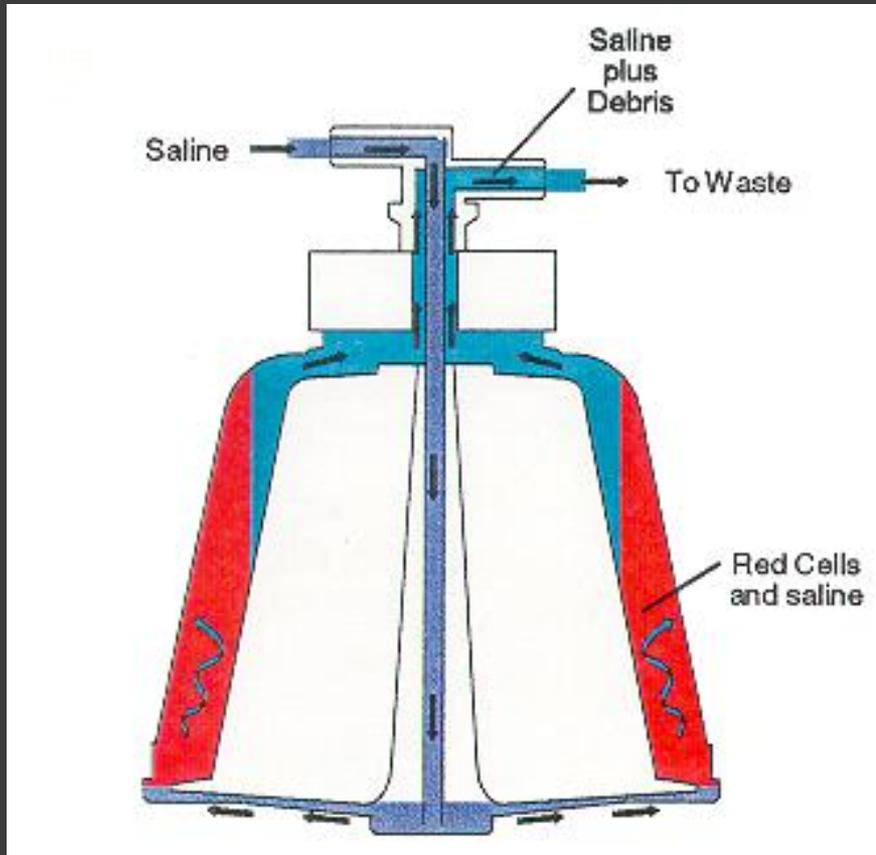
- Encroaching red cells push plasma, solutions and effluent upwards to the outlet port

# Latham Bowl Processing



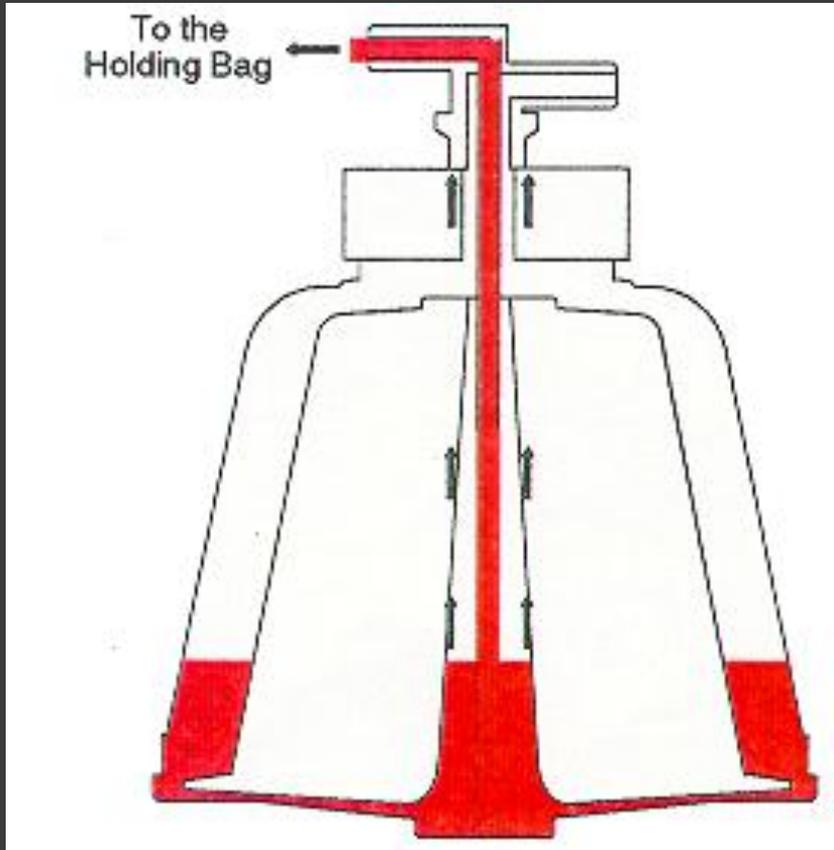
- Once sufficient red cell volume fills the bowl to the level sensor detection point, the fill process stops and wash cycle begins

# Latham Bowl Processing



- Saline is forced through the red cell layer to the outlet port
- Effluent solution is sent to the waste bag.

# Latham Bowl Processing



- After the programmed amount of saline has passed through the bowl, the centrifuge stops and the red cells fall to the bottom of the bowl
- Washed red cells are pumped to the holding bag.

# Principles of Autotransfusion with Self Starting Devices

- If the device is in the Ready mode, the FILL cycle will start automatically at the programmed weight or volume of blood in the Collection Reservoir
- Otherwise the Fill cycle can be initiated by pressing the Start button in the Ready state

# Principles of Autotransfusion with Latham and Baylor Bowl Devices

- ⦿ Automatic: the machine will automatically FILL, go into the WASH cycle and will then EMPTY the bowl
- ⦿ Semi-automatic: the machine will go into a STANDBY mode and you will have to select WASH. Once the WASH cycle is complete, you must select EMPTY
- ⦿ Continue: the machine will automatically FILL, WASH and EMPTY four (4) bowls at a time. Insure that the waste bag and holding bag are empty before selecting this mode
- ⦿ Manual: the operator must initiate the WASH cycle

# The autoLog Bowl



- ⦿ Dynamic wash mechanism via bowl indentations and pulse wash
- ⦿ First fill rate always 600 ml/min
- ⦿ Second fill rate will be 600 ml/min or 250 ml/min depending on incoming hematocrit
- ⦿ Wash volume is 250 ml for all situations

# Principles of Autotransfusion with the Latham and Baylor Bowl Devices

- Once a minimum of 3 - 4 times the bowl volume of wash solution has been used for cardiac or vascular surgery, and the line to the waste bag is clear: select EMPTY (7 to 10 times bowl volume for orthopedic surgery)
- The washed red blood cells are then pumped to the holding bag. It is advisable to drain the red blood cells into a transfer bag for later patient reinfusion

# Principles of Autotransfusion with the autoLog Device

- Only 250 ml of saline wash solution are required due to the dynamic design of the autoLog bowl
- Saline is pulsed through the bowl and each pulse is terminated when the level detector sees the red cells approaching the neck of the bowl
- The length of the next WASH pulse is determined by the length of the previous pulse
- The effluent line may not be truly clear although greater than 95% of all contaminants have been removed

# Principles of Autotransfusion with Latham and Baylor Bowl Devices

- ⦿ Factors affecting the quality of the product:
  - Fill Rate
    - Always select the rate with the patient need in mind (e.g., a trauma patient in need of volume)
    - Always completely fill a bowl; if a bowl is not full, select RETURN or CONCENTRATE functions

# Principles of Autotransfusion with Latham and Baylor Bowl Devices

## ○ Wash rate

- Try not to wash much faster than you fill with a Latham bowl
- The wash solution must be isotonic – 0.9% Normal saline is the only choice
- Always wash with a minimum of 3 - 4 times the bowl size (i.e. 750 ml for a 225 or 250 ml bowl); 7 - 10 times for orthopedic cases. It is advisable to continue the WASH cycle until the line to the waste bag is clear

# Principles of Autotransfusion with All Bowl Devices

## Do Not Wash Partially Filled Bowls

- ⦿ Very poor wash quality
- ⦿ Additional hemolysis is created by excessive saline volumes
- ⦿ A clinically insignificant red cell mass is involved
- ⦿ Use RETURN and CONCENTRATE functions as needed

# Principles of Autotransfusion

- ◎ Factors affecting processing time:
  - Bowl filling volume
  - Hematocrit of the salvaged blood
  - Bowl filling rate
  - Wash volume required (constant on the autoLog)
  - Saline wash rate (pulsed on the autoLog at 1000 ml/min)
  - Flow rate at which bowl is emptied (constant on the autoLog at 600 ml/min)

# Principles of Autotransfusion

- ① The recovered, washed red blood cells must be transfused to the patient within four (4) hours of processing
- ① Blood collected during post operative salvage must be washed and transfused to the patient within six (6) hours from the start of collection
- ① Appropriate steps must be taken to minimize the chance of air embolism when the recovered blood is being re-transfused to the patient
- ① The operator must visually confirm the quality of the washed blood prior to releasing for patient transfusion
- ① An appropriate blood administration set should be used. Minimum filtration requirements call for a 170 micron filter, although a 40 micron microaggregate set is highly recommended.

# Estimating Blood Loss (EBL)

- ① 1). Start with fluid volume in the Collection Reservoir
- ② 2). Subtract the amount of anticoagulant solution delivered to the reservoir
- ③ 3). Ask the scrub nurse how much irrigation solution was used and subtract that number from the corrected volume from step 2
- ④ Under normal circumstances red blood cell mass recovery rates should fall into the 60 to 80% range
- ⑤ Carefully monitor EBL – at 50% of a patient's blood volume lost, coagulation factor testing is warranted and Fresh Frozen Plasma (FFP) may be required. At 100% or greater of a patient's blood volume lost, coagulation factor testing and a CBC for platelet count is warranted and platelet transfusion may be required

# Principles of Autotransfusion

Contaminants such as betadine, alcohol, bleach, hydrogen peroxide, water, bone cement, gastric fluids, etc., should not be collected into the reservoir and should be removed to the wall suction, these agents will cause red blood cell hemolysis. The operator must constantly monitor the activities in the surgical field.

# Principles of Autotransfusion

- ⦿ Collagen based hemostatic agents should not be aspirated into the autotransfusion system (i.e., Avitene and Instat as well as Gelfoam)
- ⦿ Although cellulose based hemostatic agents, such as Surgicel, could accidentally be aspirated into the reservoir, large amounts of those materials should be aspirated to the wall suction
- ⦿ The product insert of the hemostatic agent should have specific statements regarding use during autotransfusion
- ⦿ Always increase anticoagulation and saline WASH volumes on Latham and Baylor bowl devices

# Contraindications

- ⦿ Cesarean section where amniotic fluid is present (momentary)
- ⦿ Grossly contaminated wounds
- ⦿ Malignancies (cancer, sepsis, tuberculosis, etc.)
- ⦿ Collagen based hemostatic agents (momentary)
- ⦿ Confirmed Sickle Cell Anemia Versus Trait
- ⦿ Others; Cold Agglutinin Antibody

# Contraindications

- The final decision on whether to salvage is the autotransfusion team's decision (Blood Bank, Surgeon, Anesthesiologist and Autotransfusionist)
- See the December 1997 AABB Guidelines for Blood Recovery and Reinfusion in Surgery and Trauma, Appendix 1: Complications of and Contraindications to Perioperative Blood Recovery: pp.19-22
- Understand that some contraindications are not absolute or may be temporary in nature
- Read the product inserts regarding the approved use of that agent or device during autotransfusion

# Prevention of Air Embolism

- ① Use a Transfer Bag, remove air and disconnect and exchange the Transfer Bag
- ① Primary cause of injury and death during cell salvage is air embolism via direct patient connection
- ① Recovered product must be inspected prior to release for clots, discoloration, fat, particulate, hemolysis and/or fluid interface

# Post-Operative Use of Autotransfusion Devices

- ⦿ Use the perioperative autotransfusion machine and disposable if both are available, otherwise use the same Collection Reservoir and Suction/Anticoagulant Line. Or use a dedicated post-op salvage device.
- ⦿ At the table, remove the suction tip and insert a Universal Y Connector
- ⦿ Cut the appropriate size elbow per the size of the Trocar line being used (1/8, 3/16 or 1/4 inch) and insert the drain line
- ⦿ Use a shorter suction/anticoagulant line if available (3', 5', 8', etc.)
- ⦿ Clamp the reservoir vacuum line for patient transport, it will hold vacuum for up to 15 minutes
- ⦿ Annotate the time and fluid level on the Collection Reservoir
- ⦿ Annotate the fluid level on the anticoagulant solution bag
- ⦿ Anticoagulation rate is the same as normal autotransfusion, i.e., 15 ml anticoagulant per 100 ml collected blood

# Post-Operative Use of Autotransfusion Devices

- Once the patient arrives in the Recovery Room, connect the reservoir vacuum line to an Intermittent Vacuum Regulator, if available
- Vacuum pressure should be set at a maximum of 80 mm/Hg
- If an Intermittent Vacuum Regulator is NOT available, it is advisable to periodically vent the Collection Reservoir
- Mark the fluid level on the Collection Reservoir if not previously completed and note the patient arrival time in the Recovery Room
- Blood must be processed and transfused within six (6) hours from the start of collection per AABB Standards
- If the reservoir is completely emptied during processing, another six (6) hour time period may be initiated
- Monitor fluid levels in the anticoagulant bag and Collection Reservoir on a hourly basis
- Terminate post-operative blood collection if drainage volumes fall under 100 ml per hour which is approximately 1.7 ml per minute or if six (6) hours has transpired without blood processing

# Post-Operative Use of Autotransfusion Devices

- Carefully observe the Collection Reservoir for clotting
- Do not allow Recovery Room personnel to strip the drain line(s)
- Vent the reservoir aseptically using a bacteriostatic filter when actively processing blood to avoid extra-vascularizing blood from the capillary bed due to excess negative pressure
- Agitate the Collection Reservoir occasionally
- If the patient is still actively bleeding at greater than 200 ml/hour, alert the surgeon immediately

# Quality Control

- AABB 4th Edition of Standards for Perioperative Autologous Blood Collection and Administration
- Devices, disposables and operators must all be carefully monitored on a frequent basis
- FDA, Joint Commission, CAP, CLIA and State Department of Health will defer to the AABB Standards
- Devices must be validated in-vitro prior to placing them into use

# Quality Control Issues

- Adequately trained personnel with annual training and recertification
- Compliance with hospital QA program and other transfusion practices
- Machine maintenance program every 500 hours or one year of operation whichever comes first by trained, qualified biomedical engineering personnel
- Complete written policies and procedures and a Medical Director responsible for the blood salvage program
- Accurate and complete case recording with archiving of records
- Review of protocol compliance; morbidity and mortality, and allogeneic blood component usage
- Appropriate labeling to include patient name, patient ID number, date and time of collection, expiration and “for Autologous Use Only” and “Donor Untested”

# Quality Control Issues

- With the product:

- Adequate testing of all components

- RBC: hematocrit, residual potassium, residual plasma protein, volume processed and returned, residual anticoagulant and free plasma hemoglobin (if available)
- The goal is to remove 95% or greater of all materials other than red blood cells
- A clear effluent line is not an adequate indicator of washout
- Periodic quality control testing must be performed
- Sampling techniques must be atraumatic and appropriate
- Collection Reservoir MUST be sampled for comparison to final washed product
- Frequency of testing is not identified by AABB. Minimum frequency may be once per quarter per operator