

## Intensive Care Nursery House Staff Manual

### Exchange Transfusion (ExTx)

**INTRODUCTION:** This procedure, used most commonly to treat severe unconjugated hyperbilirubinemia, removes the infant's circulating blood and replaces it with donor blood. The amount of blood exchanged is expressed as multiples of the infant's blood volume. The standard "two volume" ExTx uses a volume twice the infant's blood volume (*i.e.*, 170 mL/kg). The procedure is done in small increments. As the procedure progresses, relatively more of the donor blood (infused earlier) and less of the patient's own blood is removed. The washout of the infant's blood is a simple exponential function:

<u>Volume exchanged (of patient's total blood volume)</u>	<u>Patient's blood removed (% of total blood volume)</u>
0.5 volume	39 %
1.0 volume	63 %
2.0 volume	86 %
4.0 volume	98 %

These values are for washout of the vascular compartment. However, an ExTx will remove more bilirubin than shown above. This is because unconjugated bilirubin is distributed in both the intra-vascular and extra-vascular spaces, and will move rapidly into the intra-vascular space as the concentration decreases during the ExTx. Thus, a 2 volume ExTx will remove twice as much bilirubin as was in the circulating plasma at the start of the procedure. However, because of continued movement of bilirubin into the vascular space, the plasma bilirubin concentration at the end of the ExTx will be reduced by only ½ of the pre-exchange level.

**PROCEDURE:** There are several possible methods. Before proceeding with an ExTx, review the section on Intravascular Catheters (P. 25) paying particular attention to the sections on umbilical catheters.

**1. Method and types of catheters:** These methods are listed in decreasing order of preference (because of considerations of safety and effectiveness):

**A. Continuous Exchange** is performed by two operators, one infuses blood and the other simultaneously withdraws it. The best method is

- **withdrawal from an umbilical arterial catheter (UAC) and infusion into an umbilical venous catheter (UVC) with tip in IVC or right atrium.** Flush withdrawal catheter with heparinized saline every 10-15 min to prevent clotting.

Alternatives are:

- **withdrawal from a peripheral arterial catheter and infusion into a central venous catheter.** However, this is slow and the arterial catheter frequently clots.
- **withdrawal from a central venous catheter and infusion into a peripheral vein.** Flush the central catheter frequently to prevent clotting.

**B. Push-Pull Method** can be done through:

- **a single UVC with tip in IVC or right atrium.**
- **a single UAC with tip in lower aorta (below 3<sup>rd</sup> lumbar vertebra)**

**Caution: Do not perform ExTx through a UVC if the tip is in the portal circulation.**

This may cause **necrotizing enterocolitis** by markedly decreasing bowel blood flow.

**2. Technique:** With the push-pull method, use increments of 5 mL/kg. Small increments are safer and just as efficient as larger ones, provided that you clear the donor blood from the dead-space of the catheter. Do this at the end of each infusion increment by withdrawing 2 mL of blood from the catheter into the syringe and then reinfusing it.

During the procedure, the operator(s) must call out the volume in and out with each infusion and withdrawal (*e.g.*, “ten in - ten out”). A 3<sup>rd</sup> person must keep a written timed, running record of each infusion and withdrawal and of cumulative volumes to be sure that the volumes infused and withdrawn are equal.

Take 45-60 min to perform a 2 volume ExTx in a vigorous baby and longer in a sick one. If the infant is receiving O<sub>2</sub> or assisted ventilation, measure pH, PaCO<sub>2</sub> and PaO<sub>2</sub> frequently (*e.g.*, q 100 mL). You often will need to increase FiO<sub>2</sub> during the ExTx.

### **3. Important reminders:**

- Monitor ECG, blood pressure, O<sub>2</sub> saturation, transcutaneous CO<sub>2</sub> and temperature during ExTx.
- Measure pH at mid-point and at end of ExTx (more frequently in a “sick” baby).
- Measure glucose and electrolytes at end of ExTx, and glucose at 10, 30, 60 min later.
- Warm blood to 34-35° C. Warming blood to >37° C causes hemolysis.
- Agitate the unit of donor blood q 10-15 min so that cells do not settle.
- ExTx does not significantly ↓ plasma gentamicin level; do not give an extra dose.

### **4. Complications of ExTx:**

<b><u>Problem with Donor Blood</u></b>	<b><u>Effect on Infant</u></b>	<b><u>Prevention or Treatment</u></b>
Blood is cold	Hypothermia	Warm donor blood to 34 - 35° C
High K <sup>+</sup>	Hyperkalemia, Arrhythmia	Use fresh blood, monitor ECG
Low pH ( <i>e.g.</i> , 6.9)	Acidosis	Consider buffering blood with THAM if infant is unstable. This will also ↓ [K <sup>+</sup> ].
No platelets (old blood or PRBC+FFP)	Thrombocytopenia	Consider platelet Tx at end of ExTx. If ↑ risk of bleeding, also Tx platelets at mid-point.
Citrate anticoagulant	Low Ca <sup>++</sup> & Mg <sup>++</sup>	Give 30 mg/kg of dilute Ca gluconate, over 5 min at ¼, ½, ¾ and at end of a 2 volume ExTx, and if unexplained tachycardia or arrhythmia occurs.
High glucose	Reactive Hypoglycemia	Start IV glucose at 5mg/kg/min 10-15 min after end of ExTx; monitor blood glucose.

### **Partial ExTx:**

- To raise hematocrit in severe anemia: see section on Anemia (P. 108) and Hemolytic Disease of newborn (P. 121).
- To correct polycythemia: see section on Polycythemia/Hyperviscosity (P. 112).