Chapter 1

Introduction

Hematocrit is the volume percentage of erythrocytes in whole blood . The hematocrit is measured by centrifuge whole blood in capillary tube, containing small amount of heparin to prevent blood clotting, for five minutes and the amount of separated packed cell volume in percentage is read. According to sampling site, hematocrit can be done from central vein (umbilical vein) or peripheral vein (vein on hands and feet).

Polycythemia is a condition when a newborn infant has peripheral venous hematocrit of ≥65% . This value exceeds the mean plus two standard deviations of the hematocrit of the normal fullterm infants.

Hyperviscosity can be defined in the same fashion that define polycythemia. Viscosity is measured by microviscometer which most of the hospital are lacking. Therefore pediatrician uses hematocrit in making decision which infant is polycythemic and needs to be treated for hyperviscosity. When the hematocrit is between 65% to 69% only the symptomatic infant is hyperviscous, but when the hematocrit is ≥ 70% all of the infants are hyperviscous[1].

Polycythemia with or without hyperviscosity occurs in approximately 3-5% of all the newborn infants. The diagnoses are essentially based on laboratory values. Most of the investigators consider a peripheral venous hematocrit of ≥65% as a diagnostic criteria of polycythemia[1,2].

Infants at high risk for polycythemia and hyperviscosity can be prospectively identified. They are more likely to be infants of diabeticmothers, small for gestational aged infants, intrauterine hypoxic

infants, infants who receive a large placental transfusion at birth or delayed cord clamping, infants with feto-fetal transfusion and infants with maternofetal transfusion[3].

Major problems in polycythemia with hyperviscosity have been attributed to increase vascular resistance, resulting in decreased organs blood flow.

Most of polycythemic infants are asymptomatic but sometimes, in 5-10% of the infants, life threatening insult can occur to several organs such as the brain, heart, lungs, kidneys and intestine[1].

The symptoms and signs are jitteriness, seizures, abnormal electroencephalogram, respiratory distress, plethora, cyanosis, cardiomegaly and abdominal distension.

Several case reports have shown polycythemic infants developed multiple brain infarction[4]necrotizingenterocolitis[5]and neurodevelopmental handicap[6],the permanent damages that the treatment could not convert the infants back to normal.

In the experimental polycythemic newborn dogs, necrotizing enterocolitis occurred in 58% of the nontreated group at 24 hours but only in 8% of the nonpolycythemic control[7].

It is generally accepted to treat symptomatic infants with polycythemia[8]. Controlled trials in newborn cases including preterm, term and postterm infants have shown that the treated infants with symptomatic polycythemia did better neurologically when compared with those who were not treated[9,10,11]. The treated and non-treated had 3.2 and 3.7 times higher risk of neurodevelopmental abnormalities at five years follow-up than normal controls of general population respectively. There is a lack of controlled data to support the treatment of asymptomatic infants[8].

The reason why the neurodevelopmental outcome of the treated infants was not far better than the non-treated ones was because of the same exposure time to polycythemia and hyperviscosity. It has been postulated that the longer is the exposure time the greater is the risk of neurodevelopmental handicaps[1].

In order to prevent permanent damage to occur, it is important to recognize infants at risk for polycythemia, to make hematocrit determination as early as possible and give treatment to the polycythemic infants.

The treatment of infants with polycythemia and hyperviscosity is relatively simple yet controversial. The consensus is that one should perform a partial exchange transfusion, to take a particular amount of the blood out by using a well accepted specific formula to calculate the amount of blood out and replace with equal volume of either colloid or crystalloid solutions[8].

Blood viscosity is greater in infants with a venous hematocrit $\geq$70% and these infants may be at higher risk of suffering tissue ischemia.

It is well recognized that 60 and 10 percents of the infants with polycythemia at birth remain polycythemic at 6 and at 12 to 18 hours of age respectively. Therefore, it is important to consider post natal age when deciding which infants should receive a partial exchange transfusion[12]. In other words, without treatment the hematocrit will come down to normal level by itself.

The infants need to be treated as early as possible and try to avoid long exposure to polycythemia. Adult fresh frozen plasma is generally accepted as a standard fluid to be used for partial exchange transfusion in polycythemic neonates. It has been shown that plasma from an adult donor has a higher viscosity than

that of the newborn infants[13], a theoretical concern has been raised that the use of adult plasma for replacement may result in an increase in blood viscosity.

Other complications of plasma are well recognized especially contamination with hepatitis B, HIV and cytomegalovirus[14]. Other kinds of colloid and crystalloid solutions are better accepted in the AIDS era. Although there has been a mention that normal saline has been used for replacement[2], there are no outstanding published data on efficacy of the use of saline.

Therefore, the study of using normal saline solution compared with fresh frozen plasma for partial exchange transfusion in polycythemic neonates was proposed. The procedure would be done within 6 hours of life to avoid long exposure time to polycythemia in order to compare the efficacy, the events of short term side effects of both fluids and then compare the neurodevelopmental outcome in the future.

It is also justified to study the effectiveness of these alternatives of treatment and the economic evaluation also be included.