Current Perspective on Exchange Transfusion

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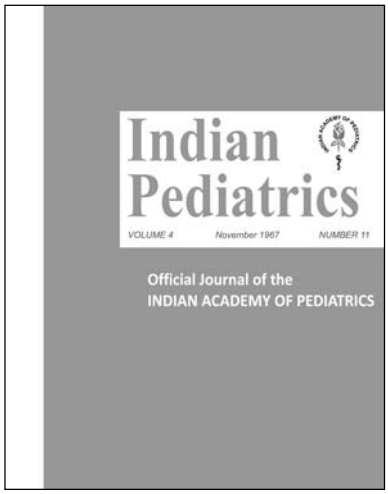
Neonatal hyperbilirubinemia (NNH) continues to be an important cause of hospital admission in the early neonatal period. The November 1967 issue of *Indian Pediatrics* had an article on "experience with exchange transfusion in the neonates." Through this communication, we present the advances and the current perspective on exchange transfusion in the management of neonatal hyperbilirubinemia.

THE PAST



The study by Mammen KC [1], published in November 1967 issue of *Indian Pediatrics*, is a retrospective review of records of 27 exchange transfusions (ET) done on 21 infants admitted in Christian Medical college, Vellore from 1964-1965. Of 3686 live-births, non-hemolytic hyperbilirubinemia was reported in 30 mature and 35 premature infants while 24 neonates had hemolytic disease (11 Rh incompatibility, 13 ABO incompatibility). The ET was performed in 4 of 30 mature and 4 of 35 immature neonates with non-hemolytic hyperbilirubinemia. Among 24 cases with hemolytic disease of newborn, ET was performed in 9 of 11 cases with Rh incompatibility and 4 of 13 cases with ABO incompatibility. There were 3 deaths reported (1 established kernicterus, 1 pneumonia, 1 heart failure in hydrops) but none died due to the procedure itself.

The author highlighted a few practical points in the technique of ET. He emphasized the use of O-negative blood (partially packed RBC), 80 cc/pound, cross-matched with mother's blood for ET, unless both the mother-baby duo had the same ABO group. Strict monitoring was recommended during the procedure keeping a tally of the aliquots and the cycles exchanged. To prevent hypocalcemia, 1 mL of 10% calcium gluconate was infused after every 100 mL of citrated blood exchanged. Besides strict surgical asepsis, the use of transparent catheter (polyvinyl feeding tube with a rounded end and side holes) for umbilical catheterization was strongly suggested, as it enabled easy identification of the air bubbles that can cause of air embolism if pushed into the circulation. The clearance of blocked catheters (clots in the circulation) using pressure was strongly reprehended. In situations where the high venous pressure was recorded or in the presence of heart failure, a deficit exchange was carried until the pressure normalized. The author felt that with the above discipline, the risk of complications due to ET can be significantly reduced.

Historical background and past knowledge: The use of ET (also known as exsanguination, venesection, or substitution transfusion) was foremost reported by Dr AP Hart in 1925 in a severely jaundiced neonate with erythroblastosis fetalis. He used the sagittal sinus for removing blood while infusing it through a peripheral venous cut-down. Louis Diamond [2] was the pioneer to utilize the umbilical vein for ET in 1946. He provided the complete technique and apparatus required for performing ET. In 1963, AW Liley introduced the technique of intrauterine and intraperitoneal transfusions in the management of severe anemia and NNH in fetuses during mid-gestation based on the spectrophotometric assessment of the bilirubinoid pigment in the amniotic fluid. Jörg Schneider was the first investigator to accomplish rhesus prophylaxis in pregnant women in 1963. Over the following years, the role of ante-partum and post-partum rhesus prophylaxis has been established that has significantly decreased the fetal morbidity and mortality.

THE PRESENT

There has been a steady fall in the incidence of severe NNH requiring ET in the current era; however, the risk of

developing acute bilirubin encephalopathy and permanent neurological sequelae still remains [3]. ET is an effective emergency intervention to lower the bilirubin levels in infants at high risk of bilirubin encephalopathy. The indications of ET in infants ≥ 35 weeks gestation are as per the AAP guidelines published in 2004, while in preterms and low birth weight neonates, the need for ET is determined by the birth weight, gestational age and the severity of clinical sickness [4]. The outcome of ET is dependent on many factors, including the indication and timing of the procedure. A modified bilirubin-induced neurologic dysfunction (BIND-M) score has been formulated to identify the neonates with severe acute bilirubin encephalopathy requiring immediate ET to limit or reverse adverse neurodevelopmental outcomes [5,6].

Over the past few decades, development and widespread use of rhesus immunoglobulin, intra-uterine transfusion, improvement in diagnostic prenatal ultrasound intensive phototherapy and intravenous immunoglobulin, has resulted in progressive reduction for the need of ET. Antenatal serial measurement of anti-D antibody levels, assessment of middle cerebral artery peak systolic velocity (MCA-PSV) and serial amniocentesis for delta OD450 can predict the risk of severe hemolytic disease and the need of ET in a neonate.

The etiology of hyperbilirubinemia requiring ET in current times is different from 1900s when severe Rh isoimmunization was predominant. The most common indication for neonatal exchange transfusion currently is hemolytic disease of the newborn due to maternal isoimmunization to blood groups other than Rh D. Besides hyperbilirubinemia, use of ET has been extended in the management of conditions like nonimmune hydrops fetalis, congenital leukemia, disseminated intravascular coagulation, sclerema neonatorum, hyperammonemia, polycythemia, fluid and electrolyte imbalance, and severe neonatal sepsis [7].

The method, equipment and precautions of the ET have largely remained the same over the years, identical to the one described by Diamond. Nowadays, we use the disposable ET tray that includes all the necessary instruments, catheters, syringes, four-way valve, pipe lines extension, bag of blood waste, with additional facility for warming the donor blood in some centers. To overcome the drawbacks of push-pull technique, Continuous Arterio-Venous Exchange (CAVE) has been proposed as an alternative [8]. The attempts to automate the ET technique have failed due to technical difficulties.

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