Effect of Fortification and Additives on Breast Milk Osmolality

This study evaluated the effect of fortification and commonly used additives on the osmolality of human milk. Osmolality after fortification with milk powder and human milk fortifier increased from 303 mOsmol/kg to 397 and 373 mOsmol/kg, respectively. The maximal increase in osmolality was seen with the addition of calcium gluconate.

Keywords: Breastfeeding, Human milk fortifier, Infant feeding.

Fortification of human milk is commonly used to achieve adequate postnatal growth of preterm infants. This can be done using either commercially available human milk fortifiers (HMF) or infant milk powder [1]. Several studies have evaluated the effect of HMF on osmolality of milk, but effect of infant milk powder and other additives has not been adequately studied. Various additives like calcium, iron and multivitamins may increase the osmolality beyond the recommended levels (<450 mOsmol/kg) [2-4]. Increased osmolality of milk has been associated with feed intolerance, delayed gut emptying and necrotizing enterocolitis [3,5,6]. We evaluated the effect of different combinations of fortification and commonly used additives on the osmolality of preterm human milk.

The osmolality was measured with freezing point depression method, using an osmometer (Osmomat 030 Germany). A thermistor probe measured the difference in freezing point of the solution measured from the reference. The instrument was regularly calibrated and was checked with internal controls for each batch of analysis of milk samples. Freshly expressed breast milk (EBM) was

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obtained from four mothers (24-28yrs old, normal nutritional status, delivered at 32-34 weeks gestation) during their second week of lactation after informed consent. The EBM was fortified by adding 1g HMF or 1g Infant milk powder to 25 mL of EBM. Osmolality was checked before and after fortification, and also after addition of several nutrients that are used commonly. This included coconut oil, multivitamin drops (containing 1000IU Vitamin A, vitamin B complex, 40 mg vitamin C and 200IU vitamin D in each mL), 3% NaCl, calcium gluconate (9.3 mg/mL elemental calcium), neutral phosphate (33 mg/mL elemental phosphate), and colloidal iron drops (25 mg elemental iron, vitamin B₁₂ 5 mcg, folic acid 200 mcg in each mL).

Fortification using milk powder and HMF increased osmolality of EBM, from 303 mOsmol/kg to 397 and 373 mOsmol/kg, respectively. Addition of additives led to a further increase in the osmolality (Fig. 1). The increase in osmolality was largest with addition of 10% calcium gluconate, and least with coconut oil (Fig. 1). Although fortification or additives added alone to unfortified milk did not increase the osmolality beyond 450 mOsmol/kg, addition of these additives to fortified milk increased the osmolality beyond this safe limit.

The increase in osmolality of milk by addition of HMF in our study was comparable to some earlier studies [7,8], but was less than that observed by Kreissl, et al. [9], who also observed marked increase in osmolality by addition of multivitamins, iron and calcium along with HMF.

Addition of additives to fortified milk should be done with caution as this may increase the osmolality of feeds beyond the safe limit. It is important to make paediatricians aware that fortification and additives increase the osmolality of milk which could potentially lead to gut injury in preterm neonates.

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Fig. 1. Osmolality of breast milk with fortification and different combinations of additives.
Papaverine for Ischemia Following Peripheral Arterial Catheterization in Neonates

11 Extremely low birth weight neonates who developed skin discoloration after peripheral arterial catheterization were given intra-arterial papaverine before the removal of arterial line. The skin color turned normal in all these neonates and none developed residual damage. In 3 neonates who could not receive papaverine, one developed gangrene of fingers.

Keywords: Arterial cannulation, complications, neonate, Vasospasm.

Vascular spasm is a common complication of arterial catheterization, and is usually temporary and reversible [1]. Heparin and nitroglycerine (NTG) ointments have been used with varied success [2,3]. Papaverine is used in cardiac patients to relieve arterial spasm, and also to prolong the patency of arterial catheters in preterm neonates [4]. We retrospectively analyzed records of 14 extremely low birth weight (ELBW) neonates who developed skin discoloration following peripheral artery cannulation. Vasospasm was defined as complete perfusion recovery within 4 hours, thromboembolism as any discoloration of the skin not recovering within 4 hours, and residual damage as events leading to gangrene or loss of function of the extremity.

In the study period from January 2012 to December 2014, 47 ELBW neonates required 54 peripheral arterial line placements, 14 developed discoloration requiring arterial line removal. These infants were given intra-arterial papaverine before the removal of arterial line (6 posterior tibial and 5 radial) provided it was patent, and NTG patch was applied subsequently. The dose of papaverine used was 1 mg/kg [5, 6] diluted with 0.9% saline (1 mg: 1 mL), and infused over 5-10 minutes. Eleven neonates (gestational age 26-31 weeks; weight 0.56-0.98 kg) received intra-arterial papaverine. The skin color became normal in six neonates within 4 hours of removal of arterial lines, and in the remaining five, it normalized over next few days; none of these neonates developed residual damage. Three neonates could not receive papaverine because of line block; two of them achieved normal skin color and one developed gangrene of fingers. The limitation of present study include: retrospective analyses, no control group, use of another co-intervention (NTG) and a small sample size. Also, doppler studies were not performed to confirm ischemia/vasospasm.

Papaverine is an opium alkaloid with vasodilatory and spasmolytic action, due to its inhibition of oxidative phosphorylation and calcium flux, during muscle contraction. An earlier study demonstrated efficacy of papaverine in prolongation of patency of arterial catheters without an increase in hypotension and intraventricular hemorrhage, even in preterm neonates [4]. It seems that papaverine is also effective in preventing residual damage in arterial catheterization-induced ischemia in ELBW neonates. These preliminary findings need to be confirmed by well-designed controlled studies.

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