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Comparative study of continuous milk feeding by *Infusion pump* versus intermittent bolus (Nasogastric/Orogastric tube) milk feeding in neonates

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Abstract

Background: Globally, about 18 million infants are born with a birth weight of <2500 gm every year. Though these infants constitute only 14% of total live births, they account for 60-80 % of total neonatal deaths. Most of these deaths can be prevented with extra attention to warmth, prevention of infections & more importantly optimal feeding.

What prompted us to do this study? Shortage of staff caused missed feeding, resulting in inadequate weight gain, even decrease in weight after initial increase. While infusion pumps were being used only for intra-venous drug infusions, we hypothesized that using them for gavage feeding could be advantageous.

The concept of continuous intra-gastric infusion feeding dates back to 1972 [Valman- source Cochrane neonatal study group].

The research questions we sought to address were:

1. Whether continuous feeding of neonates can make any difference in different aspects of growth as compared to bolus feeding.
2. Can introduction of continuous enteral feeding by infusion pump decrease human errors, be cost effective, and overall be a more efficient system

Methods: This was a prospective study over a period of 10 months [from 10th January 2017 to 9th November 2017] involving 64 babies. At a time, 2 babies were put on infusion pump continuous enteral feeding & 2 on conventional gravity bolus feeding, with a 15-day follow up. Parameters under study were – rate of weight gain, days to regain birth weight, days to switch over to regular spoon /paladai / jhinook-bati feeding, regurgitation, residual milk, abdominal distension, numbers and time durations of staff engaged in feeding of neonates. Babies were divided into 3 categories based on their weight at admission: 1). 900gm to 999gm-[12 babies] 2). 1000gm to 1249gm- [32 babies] 3). 1250 gm to 1500gm – [20 babies]

Results: Babies on infusion pump continuous feeding gained weight faster and more in all three weight categories. Babies on continuous feeds by infusion pump started gaining weight sooner, on average 6 days post-admission as compared to 7 days post-admission when on bolus feeds. Birth weight re-attainment with infusion pump feeding was likewise sooner at 14.2 days compared to 15.8 days with bolus feeding. The number of episodes of regurgitation of feeds averaged 10 over the 15-day follow-up with infusion pump continuous feeding group, as compared to average 18 episodes with bolus enteral feeding. Gastric residual volume was very less [3.66 incidence] in infusion pump continuous enteral feeding compared to bolus enteral feeding [11 incidence]. Abdominal distension – infusion pump-4.33 against 7.67 in bolus enteral feed. In infusion pump continuous feed staff time is only 18 minutes for one baby compared to 120 minutes for one baby in bolus feed.

Conclusions

1. less incidence of regurgitation in continuous infusion pump feeding compared to gravity enteral feeding
2. Tolerates feed better (less residual volume, abdominal distention).
3. Weight gain better in 900gm to 999gm & 1000gm to 1499 gm
4. Engagement of staff significantly (6.7 times) less and cost-saving too!
5. switchover to katori spoon later /comparable compared to gravity enteral feeding
6. more machine involvement
7. Accidental tube disconnection [rare]

Keywords: infusion pump, gavage feeding, gravity enteral feeding

1. Introduction

Globally, about 18 million infants are born with a birth weight of <2500 gm every year. Though these infants constitute only 14% of total live births, they account for 60-80 % of total neonatal deaths. Most of these deaths can be prevented with extra attention to warmth, prevention of infections & more importantly optimal feeding.

Indian share of low birth weight babies

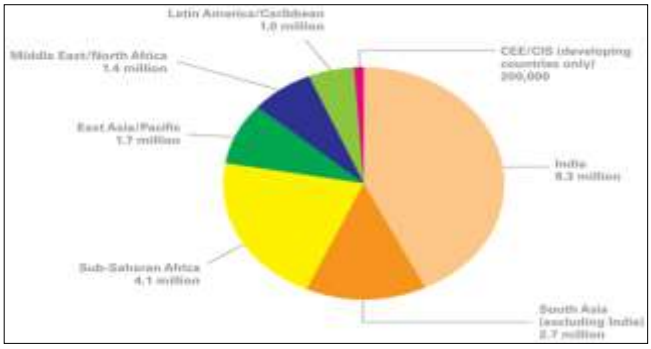

Fig 1

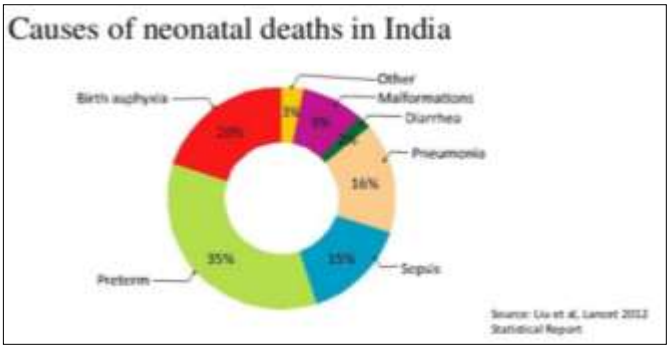

Fig 2

What prompted us to do this study? Shortage of staff caused missed feeding, resulting in improper weight gain, rather decrease in weight after initial increase. We found that infusion pumps are being used only for drugs. From there we got the idea of using infusion pump for feeding.

Feeding as continuous feeding dates back to 1972 [Val man-source Cochrane neonatal study group].

The conventional tube feeding method is intermittent bolus gavage feeding, where a prescribed volume of milk is given over a short period of time (Aynsley-Green 1982) [1], usually over 10 to 20 minutes by gravity.

The first reported use of the continuous nasogastric tube feeding method for preterm infants was in 1972 (Valman 1972) [2]. Some clinicians prefer the continuous nasogastric feeding method for feeding premature infants less than 1300 grams birth weight, although intermittent bolus gavage feeding is the method more commonly used in practice (Toce 1987) [3, 5].

Theoretical risks and benefits of both continuous nasogastric milk feeding and intermittent bolus milk feeding have been proposed. Continuous nasogastric feedings may improve energy efficiency (by increasing energy absorbed and decreasing energy expenditure) (Grant 1991) [4], reduce feeding intolerance, improve nutrient absorption, and improve growth (Toce 1987) [1, 3]. However, continuous infusion of milk into the gastrointestinal tract could alter the cyclical pattern of release of gastrointestinal tract hormones, which might affect metabolic homeostasis, and growth (Aynsley-Green 1982) [1]. Furthermore, a properly functioning lower oesophageal sphincter is an important barrier against the reflux of stomach contents into the oesophagus, and subsequent aspiration. Reflux and aspiration may be compounded in the premature infant receiving continuous nasogastric feedings. Not only do these infants have reduced lower oesophageal sphincter pressure (Newell 1988) [6], but the nasogastric tube remains in situ preventing complete closure of the sphincter.

Aims & objectives to study whether

1. Continuous feeding of neonates has an impact on different aspects of growth, as compared with bolus feeding.
2. Introduction of infusion pump for continuous enteral feeding can decrease human errors, be more cost effective, and be a more efficient overall system

Hypothesis

Enteral feeding of neonates through infusion pump in continuous mode will be more cost effective, make NICU system more effective, better weight gain, less complications in comparison to gravity gavage bolus feeding.

Materials and Methods

Fig 3

Continuous feeding by infusion pump

Fig 4

Gravity gavage feeding

Permission was taken from the MGM MCH ethical committee

Duration of study 10th January 2017 to 9th November 2017
Study material: data of babies admitted in NICU MGM MCH, for prematurity, ELBW, VLBW & babies needing enteral feeding
The necessary permissions were taken, and this study over 10 consecutive months was done in the NICU at MGM MCH

Volume of study
2 babies on infusion pump &
2 on conventional gravity feeding for 15 days

Total babies under study: 64
Milk used was EBM with HMF. At a time, 2 babies were fed by infusion pump, while 2 were on conventional bolus gavage feeds.
That gave us data from 4 X 2 = 8 babies each month. Over our study period of 10 months, 16 babies were lost to follow-up.
Tube feeding is necessary for most premature VLBWs because of their inability to coordinate sucking, swallowing, and breathing, and the danger of aspiration.
In bolus feeding –babies were given milk every 2-3 hourly. In continuous method we made 6 slabs of 4 hour each, completing 24 hours. In 4 hours, 3 hours were allocated for continuous feeds, & 1 hour for Kangaroo Mother Care [KMC]
The conventional tube feeding method is intermittent bolus gavage feeding, where a prescribed volume of milk is given over a short period of time, usually over 10 to 20 minutes by gravity that is- with the piston or plunger removed from the syringe of milk.
We made a modification in continuous feed by adding KMC as it is equally important

Selection Criteria
Otherwise healthy neonates born with birth weight less than 1500 grams who have no prior history of feeding or feeding intolerance, and no congenital anomalies that might interfere with establishing enteral feeds.
Neonates were followed up till 15th day post-admission on enteral feeds or at least 3 consecutive days of weight gain. In addition to the primary outcome of days to full feeds, we recorded feeding intolerance (feeds needing to be withheld for >12 hours), & days to regain birth weight.

Table 1: Age, weight record in NICU

NAME	REGN NO	BED NO	DATE	WEIGHT	REGURGITATION	ABDOMINAL DISTENSION	

Residual volume, apnea, or any other problems occurring were also recorded
Babies were divided into 3 categories based on their weight at admission:
1. 900gm to 999gm -12 babies
2.1000gm to 1249gm -32 babies
3.1250 gm to 1500gm -20 babies
Our review of literature had suggested that the weight bracket of 1000-1249 gm were more common and had a varying growth trajectory [Cochrane Neonatal Group
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Results

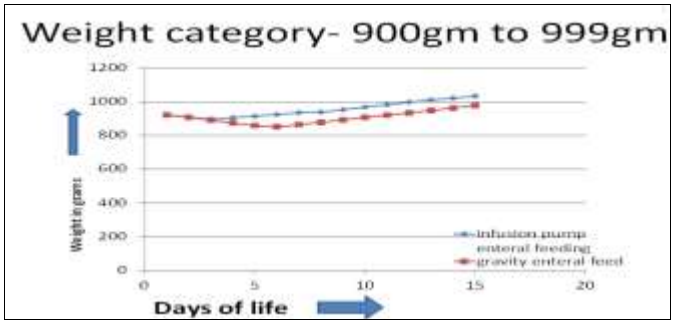

Fig 5

On horizontal (X) axis day of life is plotted as the independent variable, while on the (Y) vertical axis (mean) weight in grams is plotted as the dependant variable. Here it is apparent that babies on infusion pump feeds gain weight faster and more than those on bolus feeding

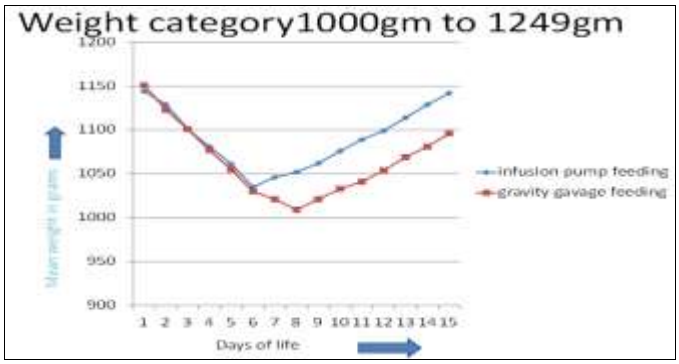

Fig 6

X axis –days, Y axis wt in grams Mean weights have been displayed here, for clarity.

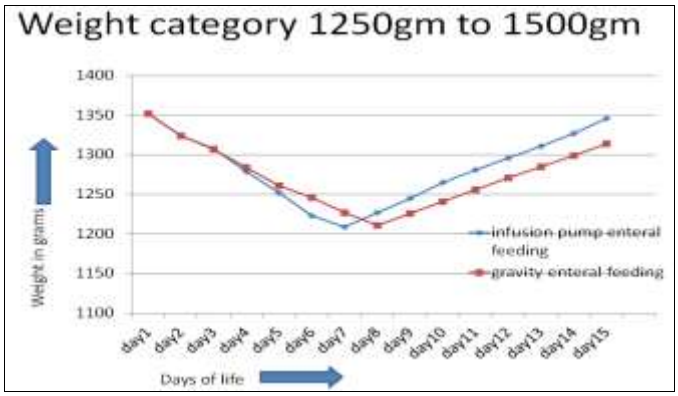

Fig 7
Mean weights have been displayed here, for clarity

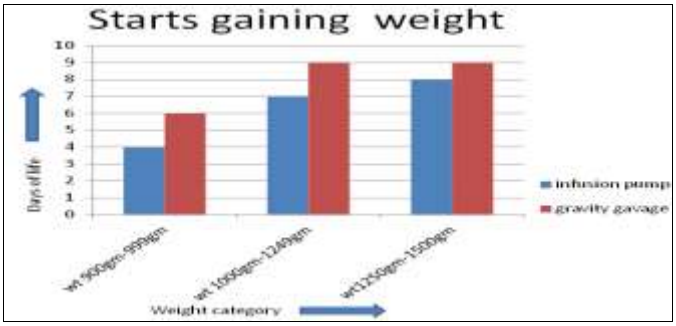

Fig 8

Mean weights have been displayed here, for clarity. Babies on infusion pump starts gaining weight on average 6.33 days compared to 8 days of bolus feed

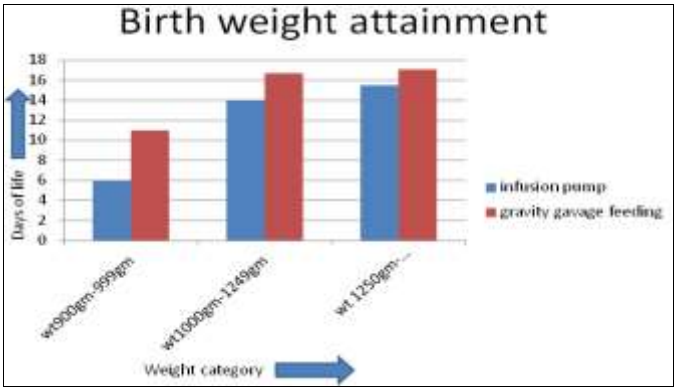

Fig 9

Birth weight attainment on infusion pump 14.23 days compared to 15.8 days with bolus feeding

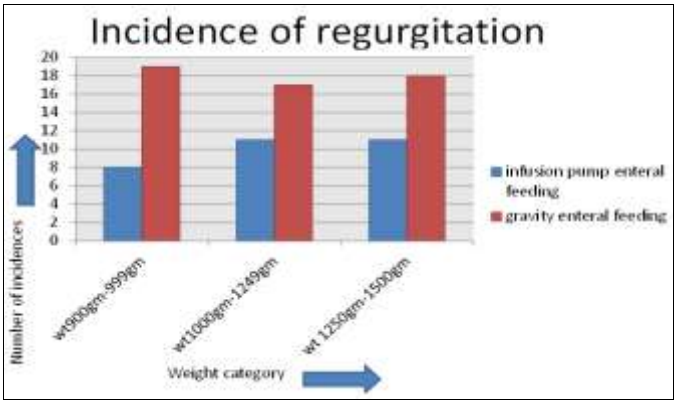

Fig 10

The incidence of regurgitation was significantly lower in babies on continuous infusion feeds (Tests for statistical significance) data analyzed by Sri Randhir Kumar, Statistician, MGMMC, Jamshedpur.
Chi square test, t test /ANNOVA FOR COMPARING two groups. Test of significance – p value 0.03
Average 10 episodes of regurgitation in infusion pump continuous feeding group compared to avg. 18 episodes in bolus enteral feeding group.

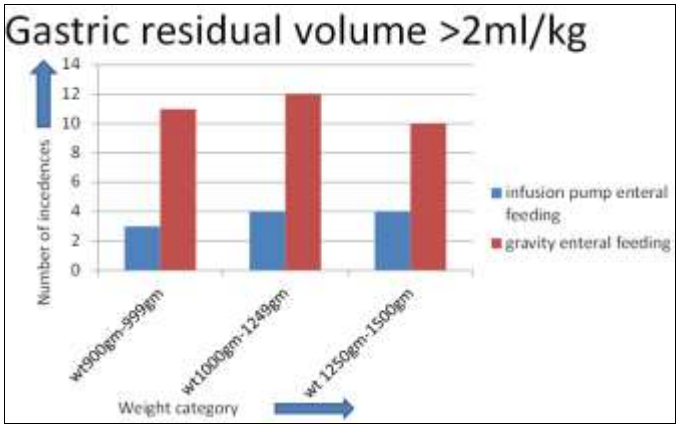

Fig 11

X axis – wt category, y axis- times of residual feed.
Generalized observation is that gastric residual is very less in infusion pump feeding
Gastric residual volume is very less [3.66 incidence] in infusion pump continuous enteral feeding compared to bolus enteral feeding [11 incidence]

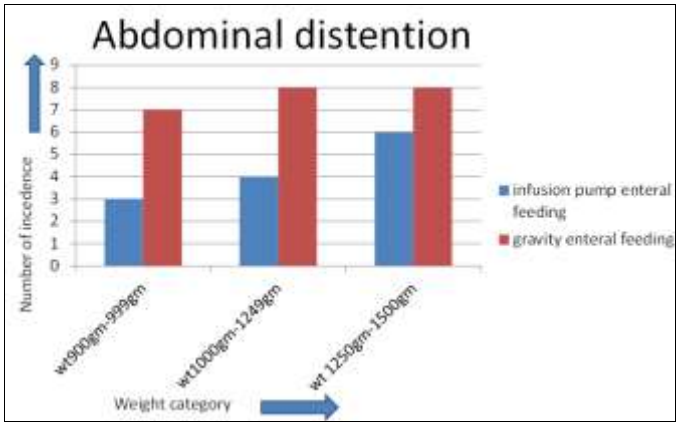

Fig 12

X axis – wt category, y axis – times of abdominal distension.
It seems that distension is more in all category in gravity gavages' feeding

Abdominal distention – infusion pump-4.33 against 7.67 in bolus enteral feed.

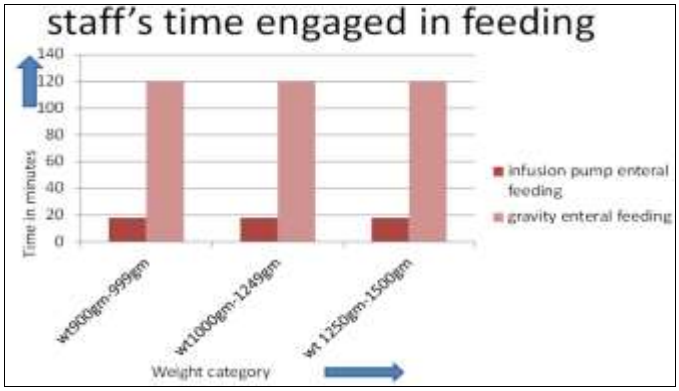

Fig 13

In gravity feeding it takes approx 15 minutes to feed a baby, but in infusion feeding it takes maximum 3 minutes to set up feeding so total in day in infusion pump takes 18 minutes compared to gravity feed 120 minutes ie. 6.66 times more work-load on staff

In infusion pump continuous feed staff time is only 18 minutes for one baby compared to 120 minutes for one baby in bolus feed in 24 hours.
T test of significance = p value 0.02

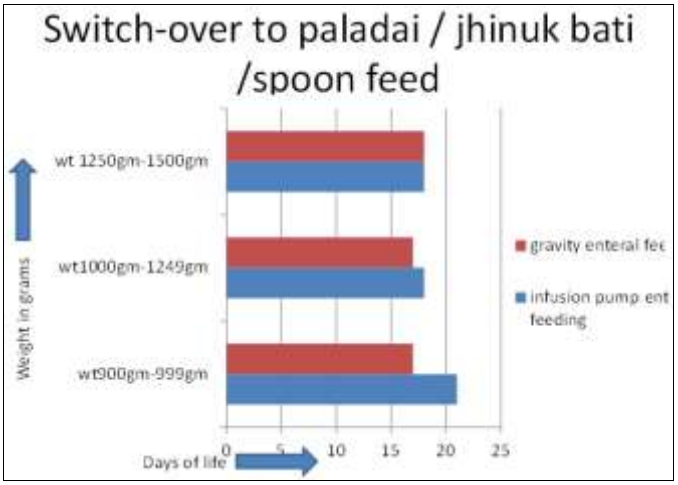

Fig 14

X axis days of life, Y axis –weight category. It seems that switch over to spoon feed is delayed in infusion pump feeding method

Observations: Pros [favoring continuous gastric infusion feeds]

1. Less incidence of regurgitation in continuous infusion pump feeding compared to gravity enteral feeding
2. Tolerates feed better (less residual volume, abdominal distention)
3. Weight gain better in 900gm to 999gm & 1000gm to 1249 gm
4. Engagement of staff significantly (6.7 times) less and cost-saving too!

Observations: Cons [against continuous gastric infusion feeds]

1. Switchover to katori spoon later /comparable relative to gravity enteral feedings
2. More machine involvement
3. Accidental tube disconnection [rare]

Conclusions

Enteral feeding by infusion pump is superior in some aspects [weight gain, less regurgitation, less staff time consumed] and almost similar/better in time to reach birth wt /start weight gain compared to gravity enteral feeding

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