A Comparative Study on Breast Milk Feeding and Formula Milk Feeding in Infants With Congenital Heart Disease After Surgery: A Retrospective Study

Xian-Rong Yu, MM, Ning Xu, MM, Shu-Ting Huang, MM, Ze-Wei Lin, MM, Zeng-Chun Wang, MD, Hua Cao, MD, Qiang Chen, MD

1Department of Cardiac Surgery, Fujian Maternity and Child Health Hospital, Affiliated Hospital of Fujian Medical University, Fuzhou, China; 2Fujian Key Laboratory of Women and Children’s Critical Diseases Research, Fujian Maternity and Child Health Hospital, Fuzhou, China; 3Department of Cardiovascular Surgery, Union Hospital, Fujian Medical University, Fuzhou, China

ABSTRACT

Objective: To explore the effects of breast milk feeding and formula milk feeding on infants after cardiac surgery in the cardiac intensive care unit (ICU).

Methods: Infants who underwent cardiac surgery in our ICU were divided into two groups, according to feeding type. Breast milk feeding and formula milk feeding were separately implemented in the two groups, and the remaining treatment regimens were the same. The related clinical data and feeding effects were recorded and compared.

Results: The prealbumin (147.3 ± 15.2 versus 121.5 ± 18.3 mg/L) and albumin (46.4 ± 4.2 versus 40.5 ± 5.1 g/L) levels in the breast milk feeding group were better than those in the formula milk feeding group (P < 0.05). Infants in the breast milk feeding group achieved a better total enteral nutrition time (3.0 ± 1.2 versus 5.2 ± 2.1 d), average daily weight gain (19.0 ± 3.4 versus 14.4 ± 2.3 g/kg·d), length of ICU stay (6.0 ± 2.2 versus 8.1 ± 2.9 d) and length of hospital stay (13.9 ± 4.2 versus 17.8 ± 5.6 d) than those in the formula milk feeding group (P < 0.05). The incidence of complications such as feeding intolerance, anemia, dyspeptic diarrhea, and nosocomial infection was lower in the breast milk feeding group than in the formula milk feeding group (P < 0.05).

Conclusion: Breast milk feeding has a definite nutritional effect on infants after cardiac surgery. It is better than formula milk feeding, making it worthy of popularization and application.

INTRODUCTION

Studies have shown that congenital heart disease (CHD) is one of the most common types of congenital malformations, accounting for approximately 28% of various congenital malformations [San Agustin 2016]. Severe CHD and pulmonary hypertension may endanger the lives of some infants. Surgical repair in infancy is the main intervention for these patients with CHD, who usually have associated malnutrition and growth retardation [Yun 2011; El-Alameey 2015]. With improvements in surgical techniques and perioperative management strategies, the operative success rate of CHD in infancy is increasing, although there are still some postoperative complications. Due to the lower muscle mass and fat percentage, the limited energy and protein reserves, and the higher metabolism and increased energy and protein requirements after cardiac surgery, infantile patients are particularly vulnerable to nutrition-related problems [Boban 2013; Prieto 2011]. Therefore, postoperative nutritional support is another important aspect of the clinical management of infantile patients after surgical repair. Breast milk has a unique composition and good immune protection, which can effectively promote the growth and development of infants and accelerate the recovery of diseases [Andreas 2015; Hassiotou 2013; Hinde 2012]. By consulting a large number of articles, few reports are found on the nutritional status and nutrition interventions of infants undergoing cardiac surgical correction. In this paper, a retrospective study was conducted to investigate the effect of breast milk feeding and formula milk feeding in infants who underwent cardiac surgical correction.

MATERIALS AND METHODS

The sample size was determined by PASS 15.0. The alpha value was set to 0.05, and the power was 0.90. According to the calculation, the minimum sample size was 48 patients. Considering a 15% dropout rate, 28 patients were included in both groups. This was a retrospective study.

A total of 56 infants who underwent congenital heart surgery at our cardiac department between March 2020 and July 2020 were included. All the patients were divided into a research group (breast milk feeding group) and a control group (formula milk feeding group). The inclusion criteria were as follows: (1) all infants were diagnosed with CHD by transthoracic echocardiography or CT examination before
The study was approved by the ethics committee of our hospital, and consent from the guardian of each research subject was obtained. Patient general clinical information is listed in Table 1. All patients underwent surgical correction under cardiopulmonary bypass and achieved satisfactory clinical results. Because our hospital is located in the city and some patients were from remote rural areas, these families could not provide breast milk in a timely manner. These infants had gastrointestinal malformation, postoperative hemodynamics were stable, endotracheal intubation was successfully removed, and the basic medical treatment was the same for both groups; and (3) family members were informed about the research and voluntarily participated. The exclusion criteria were as follows: (1) combined with severe gastrointestinal abnormalities or metabolic diseases; (2) patients with complex congenital heart disease requiring staged surgery; (3) chylothorax after the operation; (4) milk protein allergy; and (5) family members refused to participate in the study.

The total enteral feeding time, average daily weight gain of the infants, and length of ICU and hospital stays in the two patient groups were compared. The preoperative albumin and pre-albumin values of the two groups were recorded and monitored again before discharge. The incidence of complications, such as feeding intolerance, anemia, and nosocomial infections during the feeding process, were assessed. The color and quantity of gastric remnants were evaluated by gastric tube aspiration before each feeding. The diagnostic criteria for feeding intolerance were as follows: The infants had symptoms, such as gastric retention and vomiting, and gastrointestinal retention was more than 50% of the previous total feeding amount. Physical examination revealed increased bowel...
sounds and abnormal abdominal tenderness. The diagnostic
criteria for dyspeptic diarrhea were as follows: defecation
multiple times a day, mostly in the morning or after feeding,
and mushy and watery stool, with a pungent odor.

SPSS 25.0 (IBM Corp., Armonk, NY) statistical software
was used to analyze the data. The count data were expressed
as a percentage, and the measurement data were expressed
as x ± s. All data were tested for a normal distribution, and
data that conformed to a normal distribution were evaluated
by paired T tests. Sex, disease, intolerance rate of feeding,
anemia, hypoglycemia, hypocalcemia, dyspeptic diarrhea and
nosocomial infections were evaluated by the chi-square test.

\( P < .05 \) was considered statistically significant.

### RESULTS

As shown in Table 1, there was no significant difference
in age, sex, weight, disease, preoperative prealbumin level,
preoperative albumin level, operation time, cardiopulmonary
bypass time or aortic cross-clamping time between the two
groups. However, the prealbumin (147.3 ± 15.2 versus 121.5
± 18.3 mg/L) and albumin levels (46.4 ± 4.2 versus 40.5 ±
5.1 g/L) in the breast milk feeding group were significantly
better than those in the formula milk feeding group before
discharge (\( P < .05 \)). Compared with the formula milk feeding
group, the breast milk feeding group showed significant dif-
fferences in the time of achieved total enteral nutrition (3.0 ±
1.2 versus 5.2 ± 2.1 d), average daily weight gain (19.0 ± 3.4
versus 14.4 ± 2.3 g/kg·d), length of ICU stay (6.0 ± 2.2 versus
8.1 ± 2.9 d), and length of hospital stay (13.9 ± 4.2 versus 17.8
± 5.6 d) (\( P < .05 \)) (Table 2). As shown in Table 3, the incidence
of complications, such as feeding intolerance, anemia, dys-
peptic diarrhea, and nosocomial infection, was significantly
lower in the breast milk feeding group than in the formula
milk feeding group (\( P < .05 \)), and there was no significant dif-
fERENCE in hypoglycemia or hypocalcemia between the two
groups (\( P > .05 \)) (Table 3).

### DISCUSSION

CHD is one of the most common congenital defects,
and the prevalence of CHD at birth is six to 13 cases per
1,000 live births [Zaidi 2017; Liu 2013; Khoshnood 2012;
Wren 2012]. Patients’ symptoms and signs vary with the
type of heart disease. Symptoms can include shortness of
breath, cyanosis, slow weight gain, and so on. Some seri-
sous cases may cause other related complications, which can
be life-threatening. In the past few decades, there has been
significant progress in the surgical techniques and periop-
erative management strategies for CHD [Goldberg 2015].
As the spectrum of disease has changed, clinicians now face
patients who are younger, more critical, and more compli-
cated. An increasing number of patients with CHD need
surgical correction in infancy. Infancy is an important stage
of development, and infant metabolism is characterized by
not only meeting postoperative energy consumption but
also meeting the needs of growth and development [Glavin
2014]. Higher postoperative energy consumption results
in higher requirements for nutritional support. The rela-
tionship between CHD and malnutrition widely has been
studied, especially in developing countries, where the preva-
lence rate ranges from 27% to 90.4% [Venugopalan 2001].
Malnutrition in infants with CHD after surgery may be
related to the following reasons: fatigue associated with the
eating process, which might reduce calorie intake; intesti-
nal malabsorption secondary to possible low cardiac output
postoperatively; and increased energy consumption second-
ary to increased use of respiratory muscles [Radman 2014].
Postoperative nutritional status has been associated with
clinical outcomes, such as mortality, infection incidence,
and ICU and hospital stay length. Therefore, the nutritional
support of these infants after cardiac surgery is very impor-
tant to maintain organ function and prevent cardiovascular
dysfunction. The purpose of this study was to compare the
effects of breast milk feeding and formula milk feeding on
infants with CHD after surgical correction.

Kreissl et al compared the effects of using breast milk or
formula milk for enteral feeding in preterm infants on the
time to total enteral feeding and complications, and the
results showed that breast milk instead of formula milk fed
to preterm infants could shorten the time of total enteral
feeding and reduce the incidence of septic retinopathy in pre-
term infants [Kreissl 2017]. The results of our study also
were consistent with these conclusions. Breast milk feeding
in infants after cardiac surgery has several advantages. First,
there are a variety of antioxidant enzymes, digestive enzymes,
hormones and growth factors in breast milk, which have a
good effect on the gastrointestinal tract and enhance digestive
function [Zhu 2019]. Second, there is no β-lactoglobulin in
breast milk; thus, allergies are not easily caused [Hochwallner
2014; Fiocchi 2011]. Third, there are no additive ingredients
in breast milk that can increase osmotic pressure or cause
damage to the gastrointestinal mucosa. In short, all of the
above advantages can help shorten the time of achieving total
enteral nutrition in breast-fed infants. In this study, the time
of achieved total enteral nutrition in the breast milk feeding
group was an average of 2.2 days faster than that in the for-
mula milk feeding group.

Compared with formula milk feeding, breast milk feed-
ing can better reduce the intolerance rate of feeding, help to
absorb nutrients and accelerate the growth and development of infants. Studies have shown that feeding intolerance might be related to gastrointestinal infection, immature development, improper feeding, flora disorders, and other factors [Eveleens 2020]. There is a large amount of osteopontin in breast milk, which plays an important role in the anti-inflammatory response, inflammatory cell chemotaxis and immune response, and oligosaccharides in breast milk can effectively eliminate intestinal pathogenic bacteria [Manthe; Froh 2014]. This study showed that the incidence of complications, such as the intolerance rate of feeding, anemia, dyspeptic diarrhea and nosocomial infections, was lower in the breast milk feeding group than in the formula milk feeding group. The subjects in this study were infants undergoing cardiac surgery with cardiopulmonary bypass and hypothermia, so the patients may have had varying degrees of circulatory and gastrointestinal insufficiency. These advantages of breast milk feeding are more conducive to the postoperative recovery of these patients.

Malnutrition increases the incidence of complications and the health care-related costs of hospitalized patients. For infants after cardiac surgery, malnutrition means a longer feeding time and hospital stay, higher hospital costs, and mental burden on their families. The results of Fitria et al showed that although the prealbumin level was more specific in predicting the inflammatory response, the bivariate model showed a positive correlation between the prealbumin level and nutritional outcome [Fitria 2019]. In this study, the levels of prealbumin and albumin in the two groups were similar before the operation, and the postoperative levels of prealbumin and albumin in the breast milk feeding group were better than those of the formula milk feeding group, which showed that the nutritional status of breast milk feeding after cardiac surgery was better and recovered more quickly.

Our research had some limitations. The sample size included in this study was relatively small and limited to infants after cardiac surgery, so it might be unreasonable for our results to be applied to other postoperative patient groups. This was not a randomized, double-blind, controlled study. Our data collection might have been biased, there were relatively few indicators adopted, and the data might have been biased in the recording process, which could affect the accuracy of the results. Future research must take into account many factors and include a larger sample size and longer follow-up duration to further confirm our conclusions.

CONCLUSION

Breast milk feeding is effective and safe in infants after cardiac surgery. Compared with formula milk feeding, breast milk feeding in these infants can improve feeding tolerance, quickly increase body weight, improve nutritional status, reduce the incidence of related gastrointestinal complications, and shorten the length of hospital stay.

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