

Case Report

Benefit of Including Food-Derived Ingredients in Enteral Nutrition Formulas: Practical Experience from Clinical Cases

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Abstract

Recent studies would indicate that there has been an increase in the use of Blended Diet (BD) with enterally fed children. Parents report that BD has led to significant positive changes for children's physical health and wellbeing. One study has shown that BD is well tolerated and improvements in retching and gagging were observed after commencing the diet. In 2019 the British Dietetic Association (BDA) changed their position statement on BD and now encourages an open discussion with dietitians and parents about the potential risks and benefits of BD.

Commercially available formulas containing food derived ingredients have also been shown to improve symptoms of feed intolerance. A recent tolerance and acceptability study used Isosource® Junior Mix (ISJMIX); a 1.2 kcal/ ml formula with 14%

food derived ingredients (Nestlé Health Science) in children aged one to fourteen with a range of medical conditions. Improved stool consistency as well decreased gagging and retching was observed in this cohort, indicating that food derived ingredients could alleviate symptoms of feed intolerance.

This case study series provides and with an overview of four children aged between twenty-six months to ten years. The children have a range of conditions including learning and physical disabilities, digestive tract abnormalities and genetic conditions such as DiGeorge's syndrome. Reflux, constipation and vomiting were among the symptoms of feed intolerance reported. Significant improvements in these symptoms were reported following a change to ISJMIX which resulted in improved quality of life for children and their families. ISJMIX could be considered as a sole source of nutrition or in conjunction with BD when children are not tolerating a standard commercial formula.

Introduction

An emerging increase has been observed in the use of a Blended Diet (BD) as an alternative to commercial enteral formulas in children who are fed via a gastrostomy tube. A recent review of parent and caregivers' experience has reported many positive changes in children's physical health and wellbeing as a result of changing to a BD [1]. Improvements in gastrointestinal function were reported as well as social benefits when tube fed children can enjoy family meals [1]. A retrospective study including twenty-three children fed via a gastrostomy tube showed that a BD is largely well tolerated and improvements in upper gastrointestinal symptoms such as retching and gagging improved within the first three months of commencing the diet [2].

In 2019 The British Dietetic Association (BDA) issued an updated policy statement on the use of BD with enteral feeding tubes [3]. Guidance was offered to dietitians who wish to support parents and caregivers in trialling a BD [3]. As a result, dietitians feel more confident in exploring the option of BD with children in their care, particularly those who are not tolerating regular polymeric commercial formulas. Feed intolerance is a growing issue in enterally fed children and is demonstrated when the individual has difficulties in appropriately digesting the feed; causing symptoms such as vomiting, abdominal distention, constipation and diarrhoea [4]. Many parents are now showing interest in alternatives such as BD via a tube to minimise some of the issues of feed intolerance [5]. Currently, the BDA only recommends blended diet via gastrostomy tube, therefore limiting options for parents and healthcare professionals that have children on Nasogastric (NG) tubes [3].

Commercially available enteral formulas containing food derived ingredients have also been shown to be beneficial in improving symptoms of feed intolerance [6]. Improvements in stool frequency and consistency were observed in children with intestinal failure previously receiving an elemental diet [7]. Better gastrointestinal function including improved stools and decreased gagging and

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Citation: Siddiqui A, Steele V, van der Linde M (2021) Benefit of Including Food-Derived Ingredients in Enteral Nutrition Formulas: Practical Experience from Clinical Cases. J Neonatol Clin Pediatr 8: 066.

Received: February 12, 2021; **Accepted:** February 22, 2021; **Published:** March 01, 2021

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retching was also reported in a recent tolerance and acceptability study [8]. These children were changed from a standard whole protein formula to Isosource® Junior Mix (ISJMIX); a 1.2kcal/ml formula with 14% food derived ingredients (Nestlé Health Science).

This manuscript illustrates our practical experience in using ISJMIX through four case studies which include children with different clinical conditions who transitioned to an enteral formula containing food derived ingredients as they were experiencing symptoms of feeding intolerances.

Case Study 1

A child referred to as J with a history of Intrauterine Growth Restriction (IUGR) and faltering growth that is experiencing feed intolerances.

Clinical case study description

Case study 1 is of a boy who will be referred to as J. J was born via emergency caesarean section at 31+4 weeks gestation. He was diagnosed with Intrauterine Growth Restriction (IUGR) and his birth weight was 790 g (below 0.4th centile for gestation). IUGR is diagnosed when the rate of foetal growth is less than expected and can lead to complications post birth, including faltering growth, which often requires early nutritional intervention to manage [9,10]. J was also diagnosed with Chronic Lung Disease (CLD). Infants with CLD are at a higher risk of malnutrition due to having higher energy requirements which they struggle to meet orally. Enteral tube feeding is often required to minimise nutritional losses. To meet higher energy requirements, larger volumes of feed are given which can lead to poor feed tolerance. There is little evidence linked to poor feed intolerance and CLD [11].

Medical and nutritional intervention

J was first admitted to the neonatal unit at two months with neonatal jaundice and poor weight gain. He was initially on a combination of Expressed Breast Milk (EBM) and nutrient dense preterm formula via a bottle and later placed on a high calorie infant formula (1kcal/ml) to support growth. At 6 months old, it was identified that J's weight and length remained below the 0.4th centile on the boy's neonatal and infant close monitoring growth chart [9]. Mum reported issues with coughing with feeds and so an infant feed thickener was recommended, which has been reported to minimise symptoms of reflux and vomiting [12]. By the age of ten months, J had multiple admissions to hospital with bronchiolitis which was affecting his oral feeding, therefore it was agreed that a NG tube would be placed to help meet nutritional requirements on discharge when unable to do as orally as recommended by NICE guidelines [13].

J continued to have a mixture of bottle and NG feeds at home, however started having symptoms of vomiting and diarrhoea at eleven months old. There was no history of cow's milk protein allergy, particularly given his age and previous tolerance of the high energy infant formula. As the symptoms were causing weight loss, a high calorie, extensively hydrolysed whey protein infant formula was trailed to reduce symptoms. There is evidence suggesting that hydrolysed whey formulas allow faster gut emptying leading to reduction in intolerance [14]. J's mother reported that this helped with reduction in vomiting, therefore was advised to continue with this feed. At the age of one year, J showed a relapse in symptoms of

vomiting and diarrhoea. He was then placed on an age-appropriate partially hydrolysed whey protein feed (1 kcal/ml), however continued to have gastrointestinal tolerance issues such as vomiting. Continuous feeding administered via a pump was trialled as research suggests that this can minimise feed intolerance such as vomiting [15].

At fifteen months of age, J's symptoms worsened. Increased frequency in diarrhoea and vomiting were evident which in turn caused weight loss. A review by the palliative community team suggested that this was primarily feed related, as he showed no signs of infection or other illness. In view of this, as other whole protein and hydrolysed feeds showed no improvement in symptoms, J was trialled on an age-appropriate amino acid feed, to minimise symptoms mentioned previously [16]. J's mother reported within forty-eight hours, this significantly worsened vomiting. Therefore, an alternative infant amino acid formula was trialled as J was vomiting large amounts of feed and losing weight. However, this feed was not nutritionally complete and designed for infants under one year old. This was trialled for six weeks and mum reported a significant improvement overall; almost no vomits and reduced frequency of diarrhoea.

At twenty-one months of age, J had a review with the Neonatal team who were very concerned that J remained on an infant formula despite his age. It was agreed that his current amino acid feed was not suitable long-term, given that J was using this as a sole source of nutrition, and it was not nutritionally complete. Therefore, a re-trial of a partially hydrolysed whey protein feed was commenced. This was initially titrated with his current amino acid feed (half and half) and gradually increased to full feeds. This caused a recurrence in vomiting and J continued to have three to four large vomits per day. His weight had remained static for over three months.

At twenty-six months, J's weight had dropped further below the 0.4th centile, J was attached to the pump for over fifteen hours during the day and experiencing up to five vomits a day (between 150-200 mls in volume). J's mother reported that J had started to become more active and was becoming increasingly difficult to keep him still during feeds. Vomiting also increased when he was active.

J remained on a NG tube therefore BD was not an option [3,4] and ISJMIX was considered. This feed is age appropriate and more calorie dense (1.2 kcal/ml vs. 1.0 kcal/ml) than J's current feed. As J required catch-up growth, the same volume of bolus was recommended. Six 150 mls bolus feeds were recommended which provided 120 mls/kg/day and 144 kcals/kg/day. This exceeded J's nutritional requirements according to Great Ormand Street Hospital Nutritional requirements [17].

Outcome

J's mother contacted the dietitians after five days extremely pleased with J's progress. She had noted his vomiting had declined from large volumes up to five times a day to occasional small episodes. He was initially prescribed laxatives for constipation. His weight had increased to above the 0.4th centile. J was reviewed two months later and had continued to gain weight. There was some re-occurrence of vomiting up to once a week, but his mother felt this was secondary to vigorous physical activity or illness. J was more active in the day and mum reported feeling more comfortable with trips outside the home. The change to ISJMIX was a success for J. The higher calorie feed improved tolerance and resulted in weight gain as well as less time

required to administer the feed via a pump. This feed also met J's nutritional requirements, including both macro and micronutrients.

Case Study 2

A child with digestive tract abnormalities experiencing faltering growth.

Clinical case description

The following study presents the clinical case of a two-year-old girl who was born at thirty two weeks gestation. For the purpose of this case study she will be referred to as H. She has a history of Oesophageal Atresia (OA) and Tracheoesophageal Fistula (TOF). TOF is a rare birth defect that is characterised by an abnormal connection between the oesophagus and the trachea. It occurs when the foetus is developing during week four to week eight of pregnancy. TOF often occurs with OA, a condition where the oesophagus is split in two parts (one connected to the stomach and one to the throat) that are not connected to each other [18]. Both OA and TOF can be repaired by surgery, which was the case for H. Risk of aspiration is high in children with digestive tract abnormalities and feeding difficulties are common [19]. Often seen in children with OA and TOF, H also has an imperforate anus which required colostomy surgery. An imperforate anus is a condition where the anus is absent or in an incorrect location. Excretion of faecal matter is often not possible until colostomy surgery is performed [20,21]. The nutritional status of children with disorders of the digestive tract is often impacted on due to feeding difficulties, requirement for tube feeding and limited absorption capacity of the gut until adaptation has taken place post-surgery [22].

Medical and nutritional intervention

The main nutritional concerns for H were faltering growth and significant reflux which resulted in feeding difficulties and sometimes minimal oral intake. H was prescribed Omeprazole and her feed was thickened with an infant thickener with an aim to improve her reflux. H was fed via a gastrostomy feeding tube. She experienced recurrent site infections on her gastrostomy site which were treated with various antibiotics.

H underwent a colostomy reversal, her reflux resolved and the thickener and Omeprazole was discontinued. H's weight pre surgery was 9.3 kg. On discharge home, H's weight at was 8.6 kg, reflecting a weight loss of 700 g. H's nutritional requirements were calculated as follows: $82 \text{ kcal/kg (+20\% for weight gain)} = 700\text{-}800 \text{ kcal/day}$. Her protein requirements were calculated as 14.5 g using Recommended Nutrient Intakes (RNI's) and fluid requirements were 820 ml (95 ml/kg). H was receiving a high energy (1.5 kcal/ml) protein feed without fibre. This was delivered in $3 \times 140 \text{ ml}$ boluses during the day with 240 ml continuous feed overnight, both of which were delivered via a feeding pump. This feed was exceeding H's energy and protein requirements as it provided 900 kcal, 24 g protein and 600 ml fluid. This feed also met RNI values for vitamins and minerals albeit slightly low for vitamin D.

Mum expressed an interest in trialling a blended diet. Her main concern was food hygiene considerations of the preparation and storage of homemade blends. Following a discussion with H's mother about her concerns, ISJMIX was considered as an alternative formula. The inclusion of food derived ingredients is something that appealed to H's parents. The main reasons were ready to hang feed and could

be administered continuously via a pump which helped overcome their concerns about preparation and administration of a homemade BD. ISJMIX has an energy content of 1.2 kcal per ml and therefore a slightly higher volume of this feed was required to meet H's energy needs. This was of some concern given H's history of faltering growth. ISJMIX also contains 1g of fibre per 100 mls and careful consideration was given to what impact this would have on H's bowel function.

The recommended feeding regimen was 700 mls of ISJMIX which provides 820 kcal and 25g protein. It is nutritionally complete and met RNI's for vitamins and minerals within this volume. H was having tasters of oral diet which were deemed nutritionally insignificant.

Outcome

H was followed up by phone call two weeks after starting ISJMIX. This time frame would allow for H to transition onto this feed gradually in view of her previous history of feed intolerances. H's mother reported positive changes in bowel function within two to three days of fully transitioning onto ISJMIX. H was reviewed two months later where she had regained the 700 g weight loss post-surgery and was in proportion to her height. ISJMIX was well tolerated and H passed a formed stool for the first time within three days of receiving ISJMIX, indicating an improvement in bowel function. The surgical team advised that stools are likely to be of a paste-like consistency for two years post colostomy reversal therefore the improvement seen in a short time exceeded expectation.

An improvement in H's energy levels and mood was also observed. An improved quality of life was reported by H's Mum from both a parent and child perspective, as she felt H was able to provide a more appropriate diet to her child.

Case Study 3

A child with a rare genetic disorder experiencing gut dysmotility.

Clinical case description

The following clinical case is of a ten-year-old boy who will be referred to as P. P has a diagnosis of Pycnodysostosis, a rare genetic disorder characterised by spontaneous fractures, short stature, facial abnormalities as well as poorly implanted and decayed teeth. Feeding difficulties in children with the condition have been reported [23].

P also suffers from Laryngomalacia causing feeding difficulties and gastroesophageal reflux as well as obstructive sleep apnoea. Continuous Positive Airway Pressure (CPAP) is the main treatment option available to manage sleep apnoea and involves sleeping with a mask that delivers air via a pump [24]. Feeding difficulties are also common in infants with laryngomalacia and dependency on CPAP dependant at night. Gastroesophageal reflux is often so severe that it requires a fundoplication and feeding difficulties resulting in complete dependence on gastrostomy feeding.

Medical and nutritional intervention

Due to oral aversion and reduced oral intake, a gastrostomy feeding tube was placed. Fundoplication was also carried out with the aim to help manage reflux. P is solely reliant on enteral nutrition via his feeding tube to meet his fluid and nutritional requirements.

Due to CPAP treatment, overnight feeds were not a suitable option in this case. His previous feeding regimen was a fibre containing high energy (1.5 kcal/ml) polymeric paediatric tube feed. A 1 kcal/ml partially hydrolysed whey protein feed was initially considered due to poor tolerance of the polymeric feed. However, due to poor weight gain and overnight feeding being contraindicated with CPAP, the decision was made to trial a 1.5 kcal/ml peptide feed. This was not well tolerated and caused reflux and discomfort. Due to poor symptoms reported following this change, P reverted to a high energy polymeric feed.

P's school reported that he was experiencing episodes of sweating and dizziness following feeds. P was also prone to constipation and appeared to have abdominal discomfort, but it was difficult to confirm this as P is non-verbal and could not explain how he was feeling. The symptoms were like that of "dumping syndrome" [25] and it was decided to change the feeding plan to five smaller bolus feeds instead of the original three bolus feeds to fit with mealtimes. The feeding regimen continued to be a problem at school. P is very mobile and was carrying his feeding pump in a backpack for most of the day. Staff were concerned that he was missing out on activities and therapies due to being fed.

P's feed was changed to ISJMIX with the aim to relieve symptoms of feed intolerance experienced with high energy polymeric feed. While a 1kcal per ml formula with a lower osmolarity may have been beneficial in alleviating symptoms, the aim was for P was to limit time connected to feeding pump and a 1.2 kcal per ml formula was chosen.

P had a history of constipation and as recommended by NICE Guidelines [26], a fibre containing feed was preferred as ISJMIX contains 1g of fibre/100ml. The feed is also halal certified which was important for P's parents due to their religious beliefs. Six small boluses of ISJMIX was recommend as this was a better fit with P's schedule of schooling, therapy and play. ISJMIX also met P's nutritional requirements in an achievable volume. ISJMIX was introduced over a period of three weeks. Once tolerance of the new formula was confirmed, three larger blouses were administered at a faster feeding rate which reduced the time spent feeding. Full conversion to the new feeding regimen was completed over two months in total.

Initial feeding plan was six daily bolus feeds of 166ml given at 332 ml/hr to feed over half an hour. Once tolerance was established the feeds were split into four bolus feeds of 250 ml each given at 250 ml/hr to feed over an hour and then parents were happy to try three bolus feeds per day that consisted of two 300 ml bolus feeds given at 300 ml/hr over an hour and a 400 ml bolus given at 200 ml/hr in the evening. The feeding pattern fitted with rest of the family's meal pattern and school's routines.

Outcome

P's weight continued to track on the second centile throughout the feed changes and so the change to a formula with a lower energy density did not adversely affect his weight. Although very short of stature due to his condition, P's height increased from 1SD below 0.4th centile to the 0.4th centile over the past year.

Positive changes in gastrointestinal function were also reported as a result of changing to ISJMIX. Symptoms previously reported such

as reflux and constipation had resolved. Parents reported P is much happier and smiles more than before. He does not seem to have any abdominal discomfort and is no longer depended on laxatives. Over a six-month period, there were no reported episodes of the dumping syndrome symptoms. P's parents were pleased that the enteral nutrition contains food derived ingredients and reported that although P is non-verbal, he seemed happier. The reduced time spent feeding has given P the freedom to engage with therapies. Teaching staff also reported a positive impact on P's quality of life as a result of changing feed.

The change in feed provided the opportunity to simplify the feeding plan and this led to the discovery that P did not always manage all the prescribed feed throughout the day due to their parents current lifestyle. It can therefore be concluded the nutritional status was improved because the feed is nutritionally complete in 1000 ml for ten year olds which means P is now meeting full nutritional requirements which is crucial for bone health.

Case Study 4

A child with physical and learning difficulties experiencing severe reflux and constipation.

Clinical case study description

The following clinical case is of a three-and-a-half-year-old boy who was born at thirty-two weeks and will be referred to as T. He was diagnosed with Di George Syndrome at age two and presented with global developmental delay. Di George syndrome also known as 22q11.2 deletion syndrome is a genetic condition characterised by both physical disabilities and learning difficulties [27]. Comorbidities such as congenital heart abnormalities often feature in this condition [28]. Disruption to cranial nerve pathways as well as impaired development of oropharyngeal structures can result in feeding and swallowing difficulties [29,30]. Delayed speech, breathing difficulties, poor concentration and behavioural problems can also feature [31,32]. Feeding difficulties and poor feed tolerance due to malformation of the gastrointestinal tract, can impact on growth and development. Enteral nutrition via a gastrostomy is often required to meet nutritional requirements [33].

Medical and nutritional intervention

T had a history of bowel malrotation which was corrected by surgery at one year of age. He also underwent surgery to correct congenital cardiac abnormalities. On referral to dietetics at two years old, T displayed oral hypersensitivity and sensory feeding issues. He was struggling to meet his nutritional requirements orally and a gastrostomy was placed at age two years of age. T was prescribed a high energy (1.5 kcal/ml), whole protein tube feeding which contained fibre.

On review, T presented with severe gag reflex which could subsequently lead to him vomiting. Poor gut motility also impacted on feed tolerance and constipation was prevalent. He was changed to a 1 kcal/ml whole protein fibre feed due to increased weight gain this was well tolerated, but constipation did not resolve, and he remained dependent on laxatives. He was stable on the 1kcal/ml feed for a year which allowed his weight to normalise. His parents wished to trial a homemade BD to help resolve the constipation and occasional gagging. There were concerns voiced about the practicalities of using

this in nursery where the preparation of homemade blends was not possible.

A decision was made to trial T on ISJMIX which contains food derived ingredients and can be used alongside approved recipes for homemade blends [34]. The plan was to introduce these blends gradually over 4 weeks alongside a BD. A risk assessment was completed in line with BDA policy for blended diets [3].

Outcome

ISJMIX was introduced successfully, and constipation improved over a period of three weeks and after two months all laxative use could be stopped. Over the first four weeks, improvements in bowel function was observed. Reduced gagging and better feed tolerance were also reported by T's parents. The improved tolerance allowed the rate of feeding via a pump to be increased which in turn reduced time spent feeding. Total volume of feed was also reduced due to the higher energy content in ISJMIX of 1.2 kcal/ml.

On review after five months parents reported that the aim in trialling a BD was to resolve gagging and constipation. These symptoms resolved on ISJMIX and therefore they have not proceeded with the BD diet as originally planned. The introduction of ISJMIX alongside a blended diet had a positive impact on T's tolerance of his tube feed with significant improvements observed in symptoms of retching as well as constipation. His parents were pleased that T no longer relied on laxatives to manage his bowel movements. They also enjoyed creating the recipes which included ISJMIX as it allowed them to gradually introduce blended foods while being confident in the nutritional content although this did not continue. He is given the occasional blended meal, but the family decided that it was not feasible for them to do this for every meal.

T now receives a nutritionally complete feed that helped to resolve GI symptoms and maintained a healthy weight without excessive weight gain. The feeding plan is manageable and feeds are easily administered at nursery where a homemade BD is not an option. T's parents feel that he is having the benefit of food derived ingredients in his enteral formula. T now takes part in family activities and time spent connected to a feeding pump has reduced.

Conclusion

It can be concluded from the observations reported in these case studies that ISJMIX offers a solution to enterally fed children who are experiencing symptoms of feeding intolerance. It can also offer reassurance to parents and caregivers as well as dietitians in the transition from commercial formula to a homemade BD as it has a predictable nutritional content and is compatible with enteral feeding equipment. It provides an alternative to a homemade BD in hospital and school settings as well as when travelling. Reduced symptoms of intolerance including constipation and vomiting were observed in these case studies. This had a significant impact on the quality of life for the children as well as their families. ISJMIX may be considered as a sole source of nutrition or in conjunction with a blended diet when children are experiencing feeding intolerance with their current formula.

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