

## REVIEW ARTICLE

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# Interdisciplinary management of infantile colic

## *Manejo interdisciplinario del cólico del lactante*

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### | Abstract |

Infantile colic is one of the main reasons for consultation in pediatric gastroenterology and pediatric nutrition services. This pathology has multiple etiologies such as family dysfunction, gastrointestinal alterations, food allergies or intolerances, food imbalance and improper eating habits. It is acute, of sudden onset, and tends to disappear between 3 and 6 months of age. To date there is no consensus on the management protocols of this condition or indicators of therapeutic efficacy. Medications, dietary regimens and dietary supplements specific to this pathology (anti-colic) have been developed for some years to help address this issue.

This article presents a structural review of evidence on the fundamentals and progress in the treatment of infantile colic, and compiles the characteristics of this pathology, the medical and nutritional therapeutic measures, the clinical approach and the techniques to help the patient and his family. This study seeks to provide technical tools to health professionals whose target population is children younger than 2 years of age.

**Keywords:** Infantile Colic; Gastroenterology; Infant Nutrition Disorders; Infant Formula; Diet Therapy (MeSH).

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### | Resumen |

El cólico del lactante es uno de los principales motivos de consulta en los servicios de pediatría, gastroenterología y nutrición pediátrica. Esta patología posee múltiples características etiológicas como disfunción de la mecánica familiar, alteraciones gastrointestinales, alergias o intolerancias alimentarias, desbalance alimentario e inadecuados hábitos alimenticios. Es de carácter agudo, con inicio súbito que tiende a desaparecer entre los 3 y 6 meses de edad. Hasta el momento no existe un consenso sobre los protocolos de manejo de esta condición o sobre sus indicadores de eficacia terapéutica. Desde hace algunos años se han desarrollado fármacos, regímenes

dietarios y complementos alimentarios específicos para esta patología (*anticólico*). Este trabajo es una revisión de la evidencia sobre los fundamentos y avances en el tratamiento del cólico del lactante en el que se recopilan las características de esta patología, las medidas terapéuticas médicas y nutricionales, el abordaje clínico y las técnicas para ayudar al paciente y su entorno familiar. El presente estudio busca brindar herramientas técnicas al profesional de la salud cuya población objeto de atención es menor de 2 años.

**Palabras clave:** Cólico; Gastroenterología; Nutrición del lactante; Fórmulas Infantiles; Dietoterapia (DeCS).

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### Introduction

Infantile colic (IC) is a clinical entity characterized by a sudden episode —almost always in the evening— of unexpected and uncontrollable crying. It usually occurs in the third week of life and decreases by the time the child is between 3 and 6 months of age (1). These pathological features, along with the lack of international consensus on the definition, diagnostic methods and management algorithms, make the proper management of this entity difficult to achieve (2).

Several criteria for the diagnosis of IC diverge widely from each other. One of them is the duration and definitive characteristics, which are more associated to the consumption of infantile formulas. Wessel defines IC as “episodes of intense and vigorous crying at least 3 hours a day, 3 days a week for at least 3 weeks in a healthy and well-fed infant” (3, p4). This concept is the most common in the scientific literature and its incidence oscillates between 20% and 40% in infants younger than 4 months. According to the Rome III criteria, IC is defined as “paroxysms of irritability, fussiness or crying that start and stop without obvious cause, episodes lasting 3 hours or more per day and occurring at least three days per week for at least one week; and no failure to thrive” (4, p5). Furthermore, Rome IV criteria describe

it as a behavioral syndrome in infants aged 1 to 4 months of age that inexplicably cry for extended periods, and are difficult to soothe (5).

Carey (6) concludes that these manifestations are variable and are associated with intrafamilial problems. Also, Barr proposes a reduction of the crying time required to establish a diagnosis by stating that IC appears in “a healthy child whose crying is perceived as excessive by the parents” (7, p1). This definition is inconvenient because of the subjectivity it implies, and because of the difference between the parenting patterns of first-time parents and experienced parents. Based on these clinical conditions, health professionals should be aware of the regular length of crying in infants (8). According to some studies, it ranges from 1 to 2 hours with a high intensity variability that affects the percentage of adequate diagnosis (1,2).

For this review, literature databases of the last two decades were consulted on aspects such as classification, diagnostic method and integral management of IC using the following MeSH terms: infantile colic, integral management, infant, nutrition, infant formula, pharmacotherapy and probiotics. 246 articles were obtained, of which 69 were selected according to the AGREE (Appraisal of Guidelines for Research and Evaluation) criteria, including review articles, cohort studies, systematic reviews and meta-analyses.

### Pathophysiology of infantile colic

Several causes seem to increase the incidence and prevalence rates of IC in infants younger than 4 months. Prevalence is estimated between 8% and 40% according to studies by Ortega & Barroso of the Spanish Society of Pediatrics (9). Although the specific etiology of IC has not been conclusively confirmed, at least three causes have been identified: dietary, gastrointestinal and psychosocial factors (9).

### Dietary etiology

In the presence of IC, the initial etiological suspicion is usually an alteration in the pattern of food intake or in the nutritional composition of the diet. Two possible causes of this pathology include inadequate breastfeeding patterns and food intolerance or allergy.

It has been proven that there is no difference in the incidence of IC in the population fed through breastfeeding or infant formula (IF) (10). However, considering the imbalance that occurs in the physiological process of breastfeeding according to the breastfeeding pattern, a direct relationship between the alteration in this pattern and the increase in the probability of the onset of IC can be inferred (11). For example, frequent and short intakes result in an imbalance of the macronutrient characteristics of breast milk, since they favor the consumption of carbohydrates and cause an imbalance in the distribution of the total caloric value in relation to other macronutrients. These should be consumed proportionally when the breast is empty, since the composition of breast milk during each intake is rich in water and sugar at the beginning, and rich in fat at the end.

In this sense, the type of milk consumed by infants increases the available amount of fermentable carbohydrates in the intestines, which causes an increase in gas and, consequently, the onset of dyspepsia and colic (12). These patterns usually derive from poor nutritional knowledge in the family and from the lack of training of health personnel committed to breastfeeding counseling, which usually include specialists in pediatric nutrition and general pediatrics.

Gas (flatus) is generated by the metabolic pathway of fermentable carbohydrates degradation, especially glucose (Embden-Meyerhof pathway), which produces organic acids as final product. This degradation is carried out by means of methanogenic bacteria — such as *Clostridium difficile*— that produce substrates by converting

glucose and some amino acids into butyric and acetic acid, CO<sub>2</sub> and H<sub>2</sub> depending on the organism involved (13).

Such symptoms can lead to progressive infant weight loss and crying associated with food intake. These consequences are directly related to the deficiencies in initial/final lactation, and are two of the differential complications of inadequate breastfeeding patterns. Occasionally, its occurrence is considered a complication related to IC (14).

On the other hand, cow's milk protein allergy (CMPA) as a probable cause of IC is a theory that has become stronger based on the studies of Shannon (cited by 2), who postulated that allergy to the protein derived from the milk is a very probable cause of inconsolable crying in infants (15).

### Breast milk and infant formula consumption in Colombia

In Colombia, bottle and IF use in infants and toddlers is high and could be related to IC. It has been found that at the end of the first three months of life, 57% of the children are fed with formula, although the proportion decreases rapidly with age (less than 40% among children of almost one year of age). These data are similar to those reported in the 2005 National Nutrition Situation Survey (ENSIN in Spanish), in which several mothers were asked about different aspects of breastfeeding, reporting that the main reasons for not breastfeeding are: “the milk does not come out, the child refuses to suckle, the death of the baby, maternal and child illness, nipple problems and drawbacks with suction” (16, p5).

The results of the 2010 National Demographic and Health Survey (ENDS in Spanish) show that 31% of the children who receive a drink other than breast milk within the first three days after delivery were mainly given formula milk (68%), followed by tea or tisanes (8%); only water (5%); milk or water (2%); and liquid milk (2%) (17). The percentage of children who are exclusively breastfed rapidly declines during the first 6 months of life, from 63% in the first two months to 24% at five months. According to the 2010 results, the median duration of breastfeeding remained the same as the reports of the 2005 ENSIN (14.9 months), while the duration of exclusive breastfeeding decreased from 2.2 to 1.8 months (16). These data are of great concern to country authorities and urge further promotion of breastfeeding.

The results show that IF consumption is also the same, which could increase health problems caused by artificial feeding. Without data on the Colombian population, the question is whether the incidence and probability of occurrence of IC can be determined by the use of bottle and IF consumption.

### Gastrointestinal etiology

Some gastrointestinal factors can cause IC, and they are the most studied by physiology since they are related to metabolic disorders. First, it is necessary to understand that, physiologically speaking, infants go through a gastrointestinal tract maturation process, which can generate a fluctuating hormonal transit. At this stage, the low level of cholecystokinin—hormone responsible for satiety and postprandial contraction of the vesicle—and the high level of motilin—in charge of peristalsis—explain the presence of crying in patients diagnosed with IC (18).

On the other hand, the immaturity of the gastrointestinal tract of infants generates hypertonia in the internal anal sphincter. This causes a contractile wave in the evacuation process, which increases the likelihood of colic and constipation (18). These symptoms could be caused by poor breastfeeding practices, the consumption of IF or by mixed consumption (19).

Other studies report a direct correlation between IC and colitis caused by an alteration in the intestinal microbiota given the increased presence of *Escherichia coli* and *Lactobacillus lactis* (18-20). This condition is exacerbated by gas located in the gastrointestinal tract, which is increased by fermentative bacteria in the lumen, and by infant crying that generates air ingestion (15-22). Elevated levels of fecal calprotectin are physiological markers that may help infer the presence of IC, according to Rhoads *et al.* (11).

**Psychosocial etiology**

It is worth mentioning that most of the current studies on IC consider some psychosocial or behavioral factors as probable causes, such as the alteration of the paternal or maternal relationship (23-26). According to Carey (26), parental rejection is defined as the absence of warmth, affection or love of parents to their children, or their significant deprivation. This attitude can take three forms: a) hostility and aggressiveness, b) indifference and negligence, and c) undifferentiated rejection.

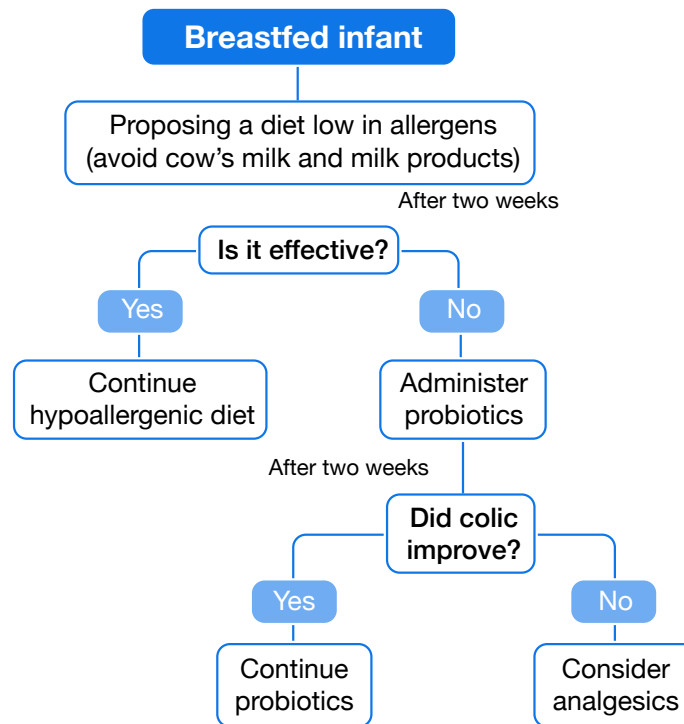
Although inadequate upbringing patterns and difficulty in acquiring adequate food are not the main causes of colic, they are factors that contribute to the onset and continuity of the disease (26). For example, the feeding pattern of the mother is directly related to their degree of nutritional culture and income capacity, which is why socioeconomic risk (measured in poverty indicators) and educational

level could be related to the risk of IC onset (27-29). For this reason, social history is relevant to make diagnosis easier and to determine the clinical behavior for treatment.

**Interdisciplinary management**

The crying of infants caused by IC can produce high irritability in the parents; this, along with the scarce or null food intake in the infant and the likelihood of associated complications such as weight loss due to hyporexia, gastroesophageal reflux without esophagitis or persistent constipation (chronic constipation), requires comprehensive therapeutic measures to respond to this pathology.

In the Colombian health system, the professionals who make the initial contact with pediatric patients are general practitioners. Occasionally, the patient is referred to the growth and development group, where a direct consultation with the pediatrician is highly possible. This is the right time to identify the possible causes of IC, request concepts from several professionals that complement the clinical findings, and decide the steps to follow. Undoubtedly, the management of this entity should begin with food and nutrition education accompanied by counseling in breastfeeding and medical-dietary treatment (Figure 1 and 2). Then, if necessary, the psychotherapeutic support of a social worker can be included and, as a last resort, if the health professional considers it after analyzing the evolution, pharmacological treatment can be initiated.



**Figure 1.** Treatment of colic of the breastfed infant. Source: Own elaboration based on Lindberg (30).

**Food education and breastfeeding counseling**

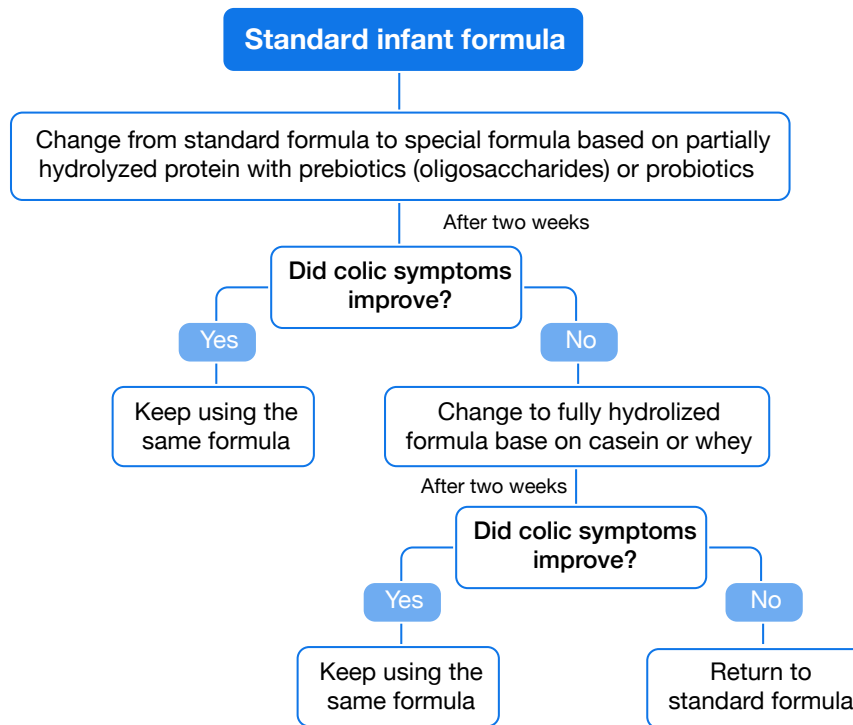
Studies by Taubman (31) showed that feeding education for the mother, as well as adequate breastfeeding techniques, could be more effective than using hydrolyzed formulas and pharmacological treatment. Soothers and relaxing and distracting massages seem to be the best way to approach IC from a family point of view. Taubman

(31) provided training to parents on behaviors to respond to crying and feeding patterns for nursing mothers; this proved to be more effective for handling IC than hydrolyzed formulas.

Breastfeeding counseling should promote the consumption of human milk before 6 months of age, which is the period when IC symptoms appear. From this age onwards, appropriate supplementary feeding should be started. In addition, it is necessary to provide

sanitary education on practices such as washing and disinfecting the elements in which breast milk or formula are preserved or administered.

Likewise, breastfeeding should be encouraged in working mothers by creating nursing areas at work.



**Figure 2.** Treatment of colic in infants fed with formula. Source: Own elaboration based on Lindberg (30).

### Dietotherapeutic management

Since the highest incidence of IC is observed between 21 and 90 days after birth, mothers should implement dietary management as a therapeutic measure. Supplementary feeding protocols from the World Health Organization (WHO) recommend the introduction of dairy products after 12 months of age, when the infant exceeds the age range in which IC is usually self-limiting. However, these therapeutic measures may also be used in older infants, always under the strict supervision of a pediatric clinical dietitian or general pediatrician (32-45).

One of the most accepted recommendations is suppressing or reducing in a ponderous way the consumption of proteins derived from cow's milk, as they produce a significant improvement of IC (46). If human milk cannot be supplied, it is recommended to replace it with casein hydrolysates, since, according to a large number of studies, the symptoms of moderate to severe IC are improved (47-50). Studies such as Zeiger *et al.* (50) show that regimens free of food allergens (dairy products, eggs, shellfish and nuts) reduce the incidence and severity of IC. This treatment is recommended for older infants (51).

Breastfeeding counseling is essential in the dietary management of IC. Breastfeeding provided on demand and completely emptying the mammary gland adequately balances the milk content and the percentage distribution of the macronutrients, thus avoiding overeating carbohydrates and their fermentation in the intestines with the complications already exposed (52-54). No conclusive studies on the use of lactose-free formulas or disaccharides in this pathology are known. However, the use of formulas with partially hydrolyzed proteins, a mixture of galactosaccharides and fructooligosaccharides,

low lactose and modification of palmitic acid in vegetable oil has shown good results in the reduction of IC (48).

The use of soy-based formulas is widely rejected, because of its low rate of acceptance due to its taste, and because the allergy to proteins derived from this legume has the same incidence as allergy to cow's milk proteins.

Given the wide offer of IF, health professionals should remember that IF should be prescribed and administered following medical indications. In addition, they should know the ingredients that benefit the management of IC, such as proteins with partial hydrolysis and increased serum proteins that facilitate digestion. By decreasing the lactose content, both digestion and lactase function improve. However, removing lactose of IF can alter bone mineralization and decrease calcium deposition. IC may be associated with constipation, so the contribution of beta-palmitic acid in these products avoids the formation of calcium soaps and, therefore, the probability of presenting minor digestive disorders (55-59).

The low presence of melatonin in soy protein isolates is another factor against its consumption. Some studies have identified a direct correlation between melatonin and decreased IC episodes, especially at night, when melatonin production in breast milk is increased by serotonin, producing a relaxing and pseudo-sedating effect in infants (60).

### Phytotherapy as an alternative or complementary dietary treatment

The use of infusions and phytotherapeutic recipes is one of the first measures of parents to deal with crying caused by IC. However, this type of practice following the popularity of "home remedies" is based

on ambiguous concepts that can sometimes exacerbate symptoms. Perry *et al.* (36) showed that fennel, chamomile, mint and verbena infusions significantly decreased IC compared to placebo.

Although these therapeutic methods are widely used, there is no consensus among studies to support their safety and determine the dose to be administered to the infant. Similarly, overdosage of phytotherapeutic agents such as anethole—an active ingredient found in aniseed—has been linked to convulsive syndrome, generalized hypotonia, and irritability due to excessive anisette in animal experiments (39-43), therefore professional management is always required.

The continuous use of herbal infusions or phytotherapies in young infants, whose gastric capacity is low, can further decrease gastric capacity and, therefore, the nutritional contribution of breast milk. For this reason, infants under this treatment are more susceptible to abnormal weight loss by hypoingestion.

### Pharmacotherapy

To treat IC, the first pharmacological line to be implemented is probiotics, especially *Lactobacillus reuteri*, because of their adequate safety spectrum and therapeutic properties. This bacterium was first isolated from the feces of a healthy human being in 1965, and has interesting therapeutic effects (59). Its role in intestinal microbiota has been documented for the treatment of IC (60), and seems to have an immunomodulatory effect on the intestines regulating the fermentation of carbohydrates, positively impacting the symptomatology (61).

On the other hand, pharmacological surfactants such as simethicone—whose function is to reduce the surface tension of gases—have not shown greater therapeutic effect than other drugs. There is insufficient evidence to opt for surfactants to treat IC (62).

Evidence indicates that dicyclomine hydrochloride is the only drug that improves the frequency and severity of IC compared to placebos in more than 53% of cases due to its anticholinergic activity. However, it has side effects such as apnea, syncope and dissociative seizures, reason why it has been excluded from the pharmacological arsenal for the treatment of this pathology (62).

### Conclusions

It is necessary to have strong diagnostic figures and clear possible causes of IC to adopt preventive measures in prenatal control programs and breastfeeding counseling. In this way, it is possible to avoid the unnecessary use of the emergency department and external consultation, thus optimizing health resources.

The management of this pathology should be interdisciplinary. IC can be addressed through holistic therapy to achieve adequate, agile and practical goals that contribute to the recovery of infants. To this effect, it is necessary to develop a clinical practice guide with contributions from different specialties. In very specific IC cases that are managed individually, a comprehensive assessment of the conditions of children and their families is required to identify whether IC is secondary to other pathologies.

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