
Clinical Review

Infantile Colic

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Infantile colic must be differentiated from other causes of recurrent irritability in infants. Several causes of colic have been described, including family stress, aerophagia (air swallowing), and the ingestion of iron supplements and cow's milk. Recent studies suggest that the elimination of cow's milk, and in some cases soy milk, from infants' diets when they are bottle fed or the elimination of cow's milk from mothers' diets if infants are breast fed decreases colic. Medications are of doubtful value in the treatment of this entity.

Infantile colic continues to be a cause of discomfort for babies, a source of anxiety to parents, and an enigma to physicians.

This paper presents an overview of recent research on the subject as well as (1) a definition and natural history, (2) a historical perspective, (3) some speculations about etiology, (4) the epidemiology, (5) the differential diagnosis, and (6) several modes of therapy.

baby with prolonged crying pulls its knees up to its chest, has a taut abdomen, passes flatus that seems to relieve its pain, but has a normal physical examination. This type of behavior is repeated daily. The paroxysms last from 30 minutes to three or four hours. Although colic seems to be most prevalent in the late afternoon or early evening, it may occur at any time. Colic resolves spontaneously in most infants by the fourth month of age.

Definition and Natural History

"The term colic is applied to any severe paroxysmal pain occurring in the intestines¹ or abdomen. Infantile colic occurs in the first three to six months of life. The diagnosis is made when a

Historical Perspective: The 20th Century

In 1897 Holt, in his original textbook on pediatrics,¹ stated that infantile colic was caused by sugar and proteids in milk. His treatment for colic was to dilute with water the formulas babies received.

By the mid-1900s, American physicians were focusing on the emotional causes of colic. Mothers in particular were scrutinized^{2,3} and often blamed for their infants' discomfort.

A multifactorial approach to colic was adopted

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by physicians during the past decade. Clinicians theorize that the emotional aspects of the family in combination with feeding techniques, and perhaps the proteins and sugars in milk, all play a role in infantile colic.

Etiology

As for sudden infant death syndrome, there are probably a variety of causes under a variable set of circumstances that produce colic.

Does emotional stress in families cause colic? Families that have a colicky infant certainly have another source of stress. These families are confronted by a new member who cries loudly and persistently and is difficult to comfort during these episodes of colic. The issue of whether these families were predestined to have a colicky baby has not been answered, although several articles on the subject have been written.^{2,3}

Most papers on colic state that colicky infants have or pass an increased amount of gas. However, this fact has never been proven in children. In one recent study in which adult patients complained about an overabundance of gas, there was no increase in the amount of gas found in the intestine. Using an argon washout technique, Lasser et al⁴ found that both the control (asymptomatic) group and the study (abdominal pain) group had the same amount of gas in their intestines. The difference was what happened to the gas. In the study group gas refluxed into the stomach more often than in the control group. In addition, the gas had a longer transit time from mouth to anus in the study group. Despite these data, parents frequently tell pediatricians that their children with colic seem to have a lot of gas. Parents also state that their infants obtain relief after passing flatus.

One cause of abdominal distention with gas is aerophagia, the swallowing of air. Situations that cause aerophagia in an infant include crying while eating, use of a poorly shaped or poorly fitted nipple, infrequent burping or improper burping techniques during meals, and frequent attachment to and detachment from the breast or bottle.

Another hypothesis about the etiology of colic

is that it is associated with the delivery process. In a 1981 study, Thomas⁵ noticed a higher incidence of colic in infants from primiparous mothers who had prolonged labors and who required forceps deliveries after epidural anesthesia. This paper has a serious methodological flaw. For obvious reasons, there was neither a randomized selection of patients who received an epidural block nor a randomized selection of patients who were delivered with forceps. What the study showed, in a retrospective fashion, was that primiparous women were more likely to have colicky babies than multiparous women.

Milk has always been suspected as a cause of colic in bottle-fed infants, but why do breast-fed babies, who do not directly receive cow's milk, develop colic, too? Jakobsson and Lindberg⁶ studied this problem in 18 mothers whose 19 infants were nursing. The authors found that milk intake by the mothers correlated with colicky symptoms in 13 of 19 babies. These researchers found that cow's milk protein could be passed on from mother to child in breast milk. The selection process in this study poses a problem; many of the families studied had allergic histories. Furthermore, the study was not blinded; both the mothers and the observers were aware of when cow's milk was being ingested by the mothers.

Evans et al⁷ refuted Jakobsson and Lindberg's hypothesis. They observed 20 mothers in a double-blind placebo-controlled crossover study and found no relationship between maternal ingestion of cow's milk and colic in their breast-fed offspring. The authors used soy milk with vanilla flavoring as the placebo. Although their study groups were small, Evans and his co-workers created an excellent research design. They did not study whether soy milk proteins pass through breast milk like cow's milk protein, however. This may have created an inadvertent bias. Lothe et al,⁸ in another study, found that 53 percent of bottle-fed infants who had a colicky reaction to cow's milk also had a colicky reaction to soy milk. Applying these data to the study by Evans et al, if soy milk protein does pass through breast milk, then the researchers would have chosen an inappropriate placebo.

A second paper by Jakobsson and Lindberg⁹ reported a study of ten infants who were breast

Continued on page 111

Continued from page 108

fed, had colic when their mothers ingested milk, and were free of symptoms when their mothers were not drinking milk. In a randomized double-blind crossover study, these mothers were given whey, which is a highly allergenic protein derived from milk. Nine of ten infants whose mothers were given whey reacted with signs of colic. The authors concluded that colic is caused by an allergy to milk protein. They failed to use skin tests, however, and they neglected to challenge the infants directly with either cow's milk or whey.

In bottle-fed infants, additives to formula have been implicated as causes of colic. The effects of iron-enriched formula were studied by Oski.¹⁰ Ninety-three infants were divided into two groups. One group was given iron in the formula (study group), and one group was given formula without iron (control group). The results were that both groups had approximately the same percentage of infants with colic (10.2 percent in the control group and 11.4 percent in the study group). This study does not define whether there is a group of infants who become colicky on iron-fortified formulas and become asymptomatic when iron is deleted from their diets.

In a study by Lothe et al,⁸ 60 bottle-fed infants with colic were treated in a double-blind fashion with soy milk and cow's milk. Eleven infants who had colic on cow's milk improved on soy milk, whereas 32 infants were worse or unchanged on soy milk but improved with a formula that utilized hydrolyzed casein. In 17 infants the signs of colic resolved spontaneously during the test period. These babies remained asymptomatic on cow's milk formula. This study has several methodological flaws that might have biased the results. First, the study was not really double blind. Both the smell and the taste differ markedly among the various formulas used. Second, some of the babies in this study were also breast fed, which may have improved or worsened the colic independent of the formulas those infants were taking. Third, there was a high incidence of families with a history of allergy.

Although current research on colic is becoming increasingly sophisticated, it has not defined the cause of colic. In fact, the most recent studies are

focusing on milk protein just as Holt did in the late 1800s. Studies will probably never prove a single hypothesis on the cause of colic. Instead, it is most likely that a multifactorial etiology will be delineated that includes not only milk proteins but hereditary predisposition, emotional factors, and feeding techniques as combined causes of colic.

Epidemiology

Colic, seen more often in Westernized modern cultures than in other cultures,¹¹ occurs in 10 to 40 percent of newborn infants studied. It is seen more often in babies whose parents are professionals than in those whose parents are skilled or unskilled workers.¹²

Differential Diagnosis

The differential diagnosis of a crying and apparently colicky infant includes many diseases (Table 1). Most diagnoses can be eliminated by taking a careful history and doing a thorough physical examination.

Infection, especially of the urinary tract, can produce signs similar to those of colic in an infant. Urinary tract infections may also cause fever and more sustained irritability than infantile colic. Infection of the urinary tract must be ruled out by urinalysis and urine culture. Infection of the penis secondary to circumcision and other skin infections caused by pathogenic bacteria abundant in the nursery may also cause discomfort in an infant. Gastrointestinal infections usually cause diarrhea in addition to colicky pain. In general, neonatal infections are as ubiquitous as those at other stages of life and may also involve the ears, cerebrospinal fluid, heart, lungs, hematopoietic system, extremities, and so on. Any infection in an infant may cause irritability and may therefore mimic colic.

Table 1. Differential Diagnosis of Signs of Colic

Increased emotional tension in the family Infection Seizures Masturbation Acute abdomen Gastroesophageal reflux Milk allergy Lactose intolerance Constipation Faulty formula preparation Chemicals from maternal milk Increased salt load from maternal milk Infants of drug-addicted mothers Iatrogenic causes from medicines or immunizations
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Seizures are usually paroxysmal events that may simulate colic. The duration of seizures is generally shorter than that of colic, and they often involve rhythmic movement of the extremities.

Masturbation in early infancy has been mistaken as infantile discomfort.¹³ Observed mostly in female infants, this behavior may also be confused with a seizure.

There are multiple causes of acute abdominal pain in infants. Included in this group are volvulus, intussusception, appendicitis, torsion of testis, torsion of the ovarian pedicle, and incarcerated hernias. These diagnoses are entertained when signs additional to those seen in colic are present. With severe abdominal pain of this nature, infants may also have anorexia, vomiting, diarrhea, melena, hematochezia, pallor, and sometimes lethargy.¹⁴

Gastroesophageal reflux may also be misdiagnosed as infantile colic. Reflux in infants, however, is usually associated with a history of "spitting up" or vomiting. Gastroesophageal reflux may also cause the infant to fail to thrive, to develop pulmonary signs,¹⁵ and to position itself abnormally.¹⁶ This condition may be associated with a hiatus hernia.

Milk allergy must also be included in the differential diagnosis. This entity may be recognized by signs not usually seen in infants with colic. Allergy

to milk can cause emesis that is fairly intense and diarrhea that often contains blood.¹⁷ Milk allergy seems to occur in infants with a positive family history for allergies. The diagnosis can often be confirmed by skin testing.¹⁸

Lactose intolerance can cause colicky symptoms in an infant. In addition, it may produce vomiting and profound diarrhea. Lactose intolerance is probably a rare cause of abdominal pain and abdominal distention in infants.¹⁹ It may be differentiated from colic because the stools in a baby with lactose intolerance will be positive for reducing substances and have a low pH (<5.5).

Constipated infants may have pain and distention of the abdomen and may appear to pass more flatus than usual. These infants can be recognized by history and often by careful abdominal and rectal examination.

Improper preparation and administration of formula can cause an infant to be irritable. For example, formula that is too dilute may result in a hungry baby. One that is too concentrated can result in serious renal and electrolyte problems because of the high osmotic load.

Breast-fed infants can develop colic as readily as bottle-fed infants.¹¹ Some breast-fed babies become irritable because of specific substances in their mothers' milk. These infants may be receiving medications taken by their mothers, who inadvertently pass them on to their offspring in their milk.^{20,21} Infants may also be exposed to a high salt load in breast milk secondary to an infection in their mother's breast or maternal cystic fibrosis, or for undetermined reasons.^{22,23} These babies are usually described as being lethargic but occasionally may be irritable and inconsolable.

Irritability is seen in infants born to mothers on heroin, methadone, and other addicting drugs.²⁰ Withdrawal signs are often seen within the first few days of life, however, before the signs of colic usually develop.

Iatrogenic causes of colic-like signs include medications given to babies. In this category are diphtheria-pertussis-tetanus (DPT) immunizations, as well as the common antihistamines and decongestants used in cold remedies.

After other causes of paroxysmal irritability and paroxysmal abdominal pain in particular have

Continued on page 114

Continued from page 112

been excluded, a diagnosis of infantile colic may be made. Infantile colic is a diagnosis of exclusion. It is not a true disease because there is not a consistent pathophysiological process associated with it.

Modes of Therapy

If the signs of colic are only mildly upsetting to the infant and the family and a recent physical examination has been done, the problem may be handled by telephone. If it is feasible, the physician should try to speak with all members of the household. During the telephone call each person in the family can be asked to carry out age-appropriate tasks to help the infant during the colicky period. The therapist may suggest, for example, that the older brother retrieve the warm water bottle. The sibling is instructed to give it to the parents, who fill it and place it under the colicky baby. In addition, the mother and father may be asked to alternate taking care of the colicky infant at half-hour intervals.

An important point about therapy is that it probably should be delivered to the entire family. Therapy prescribed for the infant alone or for the infant's primary caretaker alone excludes other family members and leads to an uneven distribution of responsibility regarding the baby's care.*

When an infant has severe colic with intense crying and obvious pain over prolonged periods of time, or when parental anxiety is high, it is advisable for the family to make an office visit. An office visit has several advantages over a telephone call. First, it allows the physician to witness the infant's behavior and watch the family's response. Second, the eating process can be observed to see if the infant is becoming aerophagic because of mechanically poor nipples or faulty feeding technique. Assessment of the feeding technique includes noting how the formula is prepared when the infant is bottle fed and whether the infant is crying while eating. A baby who cries while feeding is likely to swallow air. Feeding a crying infant may further reinforce the very behav-

ior one is trying to end. Watching the parents burp the baby is crucial. Some parents are not vigorous enough when burping their infants and some may be too rough. Sometimes babies are burped too infrequently during meals. Third, the office call allows the family to discuss its concerns face-to-face with the infant's physician or nurse. The cause of the colic, who is to blame for it, how it interferes with the lifestyle, and what the family as a whole can do about the situation are topics that are frequently discussed. In that way the office call allows the primary caretaker to share the responsibility of caring for the colicky infant with other members of the family. Fourth, a physical examination may be performed to rule out other causes of irritability, thereby reassuring the family that the infant does not have a more serious disease.

The infant with colic may benefit from some simple prescriptions. For example, a warm water bottle may be placed under the infant's abdomen while it is lying prone. Swaddling babies in their blankets or bathing them in warm water has also been tried with some success. Motion sometimes helps an infant with colic; a car ride or an automatic swing may be utilized. The author has seen the movement of tropical fish in a tank mesmerize and placate colicky infants.

If the techniques described fail to decrease colic and the family is not comfortable waiting for the colic to disappear, another step must be taken. In breast-fed infants this step can be the elimination of cow's milk from the mother's diet. In a bottle-fed infant, the formula may be changed to one that contains less iron. Another choice is to change from cow's milk formula to soy milk or even to a hydrolyzed casein formula.

Finally, there are medications that have been used for infants with colic. Traditionally, sedatives (eg, whiskey, phenobarbital) were prescribed. Anticholinergic and antispasmodic medicines may be prescribed individually under generic names such as belladonna or dicyclomine. Both generic medicines are also produced in combination with other drugs under brand names such as Donnatal and Bentyt with phenobarbital. Antiflatuents, including simethicone, have been used as well. Simethicone has the advantage of not being absorbed from the gastrointestinal tract.

Continued on page 116

Continued from page 114

A study by O'Donovan and Bradstock²⁴ questions the value of medication used for the treatment of colic. The authors evaluated the effect of medication on 97 children divided into four therapeutic groups. Drugs were given to three groups, and a placebo was given to the fourth group. Medication was successful in at least 70 percent of the patients in each of the medicated groups. In the fourth group, placebo was 84 percent effective. The conclusion that may be drawn from this paper is that the placebo effect of medication in the treatment of colic may be as high as 80 percent or more.

Prognosis

The outlook for babies with colic is excellent. Most "outgrow" their symptoms by four months of age. While no prospective studies are available that compare personalities of colicky infants with those of a control group of infants, it is the author's opinion that colicky babies are often especially delightful toddlers. Maybe once these youngsters are free of abdominal pain, they can enjoy themselves that much more.

Conclusions

The diagnosis of colic is made by excluding other causes of paroxysmal irritability in infants. Some of the possible causes of colic include prolonged maternal labor, intolerance to various types of milk, and aerophagia. The treatment plan for colic should probably include the entire family. In addition, simple remedies may be tried to comfort the baby such as bathing it in warm water or taking it for a ride in the car. Changes in maternal diet or infant formula may be undertaken if simpler measures are unsuccessful. Finally, medications

for colic are probably not helpful and should rarely, if ever, be prescribed.

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