AMERICAN HEALTH CONSULTANTS®

Primary Care Reports™

The Practical, Peer-Reviewed Journal for Primary Care and Family Physicians

Volume 7, Number 6 **March 19, 2001**

Infantile Colic

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Editor's Note—*Infantile colic is a syndrome characterized by periods of intense inconsolable crying with no identifiable cause. Colic affects about 10-25% of all infants and usually occurs suddenly between 2-3 weeks of age and lasts up to 3-4 months. It is thought to be a condition that is self-limited and benign.[3,20] Risk factors that influence the reporting of infantile colic include increasing maternal age, socio-economic status, and lower parity.[5]*

Infants with this condition cry inconsolably for periods lasting more than 3 hours, more than 3 days a week, for a 3-week-or-more period of time. During this period of time, the otherwise healthy infant can display paroxysms of leg flexion, fist clenching, facial grimacing, and at times excessive flatus.[14,24] Infants with colic have been found to be more alert, spend more time crying and irritable than in the quiet alert state, have shorter continuous sleep periods, and display excessive activity or restlessness.[10]

This common condition will be seen by most primary care medical providers (PCPs) who see infants as a part of their practice. Hence, PCPs need to learn strategies for management of these infants and their frantic and worried families. Management strategies include empathy, reassurance, support, encouragement, the development of treatment strategies with the parents, and the provision of any necessary medical information.

Introduction

Nothing can crumble the facade of confidence, self-reliance, and self-assurance more than a baby's unremitting, unrelenting, and implacable cry from colic. Nothing can remove the veneer of self-confidence of educated or even experienced parents more than having the healthy newborn infant who they are so proud and happy to have as a part of their family, cry inconsolably (at times day and night) from infantile colic. The guilt, recriminations, and sleepless nights are unsurpassed as methods of torment. It becomes so overwhelming that this condition may lead to many changes in feeding practices, use of varied over-the-counter products, additional doctor's office visits, and even emergency room visits. There are also the hidden costs for the parents of these infants, days spent out of work or at less than peak efficiency due to chronic insomnia, and increased psychological stress in a time period already known for postpartum depression.

Description of Syndrome

Colic by definition (developed by Wessel and associates and Illingworth in 1954) is a behavior syndrome of paroxysmal high-pitched crying that is nonsoothable and usually occurs in the evening.[8,13,26] This syndrome is not related to the gender of the infant or whether the infant is breast fed or bottle fed.[5]

Colic could be viewed as a family complaint. The

excessive crying has a great effect on the health and well being of the lives of the entire family.[13] Parents often complain that the cries of their infants are more piercing, grating, distressing, discomforting, irritating, and urgent than the cries of other infants.[13] This is not just caregiver bias as other family members, friends, and medical personnel agree that the cries of colicky infants are distinctive. Interestingly, acoustical analysis of the cry of colicky infants varies greatly from their noncolicky counterparts. The cry of an infant with colic is higher in pitch, has more variability, and contains more turbulence and dysphonation. Technical terms characterizing sound have been used such as the colicky cry being higher in jitter, shimmer, proportion of noise and tenseness than the cry of a nonafflicted infant.[13]

Differential Diagnosis

Infantile colic is a diagnosis of exclusion. It applies to a normal, healthy infant who gains weight appropriately and suddenly manifests these unusual and prolonged episodes of crying. Scheduling office visits in the evening for the evaluation of these infants is helpful, because that allows the medical provider to observe the crying behavior and the caretaker's reaction to it when the symptoms are the most severe.[14] Typically, there is no previous history of perinatal or neonatal illness. A physical examination to exclude acute causes of crying such as trauma (testicular torsion, physical abuse), infection (otitis media, UTI, sepsis, meningitis), drug reactions (DPT immunization, narcotic withdrawal), or serious gastroenterologic dysfunction (esophagitis, pyloric stenosis, incarcerated hernia).[6,25] Evaluation of the infant's diet and feeding practices, stooling, urination, crying, and sleep patterns should be performed. An evaluation of the home environment or a home visit can be helpful in investigating the infant's and his or her family's social situation. Identifying who lives in the home and what their roles are in child rearing can be very valuable in treatment and support of the parents and other caregivers during this period of time.[1]

Causes of Infantile Colic

Although the etiology of infantile colic is still unknown, many theories have been formulated about the development of this condition. Even so, no one theory has been proved convincingly. Theories fall into gastroenterologic, and nongastroenterologic categories.

Gastroenterological Causes

Signs including abdominal distention passage of flatus, borborygmi (stomach rumbling), and apparent abdominal pain as evidenced by facial grimacing and leg flexion have led many to believe that colic may be due to excessive gas. There could be 2 different sources of this gas—excessive crying could lead to increased air swallowing, and colonic fermentation from non-digested carbohydrates.[24]

During feeding and crying, a large amount of air may enter the stomachs of infants with colic. If aerophagia were the cause of colic, then holding the baby upright and frequent burps would allow the air to leave the stomach and eliminate symptoms. Since this is the usual treatment first tried at home by caregivers and is then reinforced by PCPs, this maneuver cannot be a cure for an infant with colic. It is safe to conclude that although this may occur in colicky infants, it is the result and not the cause of this syndrome.[24]

The usual diet of newborn infants contains a large amount of carbohydrates from milk products. A proportion of normal infants have malabsorption of these carbohydrates, especially lactose.[1,7,24] This could lead to anaerobic colonic fermentation of unabsorbed carbohydrates by bacteria leading to gas production of carbon dioxide and hydrogen.[1,24] The physiologic malabsorption resolves at around 3 months of age, which corresponds with the resolution of colicky symptoms.[24] However, in clinical studies measuring breath hydrogen levels, no discernable difference in the production of hydrogen between patients with colic and controls was found. Also, studies done decreasing the amount of lactose in the diet of colicky infants show no improvement in symptoms.[24] It appears that gastroenterological causes of colic can only explain symptoms in a very small proportion of infants.[20]

Evidence of hypersensitivity of the gastroenterologic tract as the cause of colic comes from studies that looked into the ingestion of cows' milk formula, or the maternal intake of cow's milk in breast-fed infants, as

Primary Care Reports™, ISSN 1040-2497, is published biweekly by American Health Consultants, 3525 Piedmont Rd., NE, Bldg. 6, Suite 400, Atlanta, GA 30305.

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MARKETING PRODUCT MANAGER: Schandale Kornegay.
GST Registration Number: R128870672.
POSTMASTER: Send address changes to ***Primary Care Reports™***, P.O. Box 740059, Atlanta, GA 30374.

Periodical rate postage paid at Atlanta, GA.
Back issues: $23. Missing issues will be fulfilled by Customer Service free of charge when contacted within one month of the missing issue's date.

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Subscription Prices

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$299 per year (Student/Resident rate: $150).

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Statement of Financial Disclosure

In order to reveal any potential bias in this publication, we disclose that Dr. Clemons (author) reports no consultant, stockholder, speaker's bureau, research, or other financial relationships with companies having ties to this field of study.

Table. Proposed Etiologies for Infantile Colic

Gastroenterologic Causes	Nongastroenterologic Causes
Excessive gas	Variant of normal crying behavior
Malabsorption	Atypical parenting
Hypersensitivity to dietary components	Atypical feeding practices
Intestinal hypermotility	Atypical parent-child interaction
Gastroesophageal reflux	Hypersensitivity or immaturity of the CNS
Hormonal factors	Maternal postpartum depression

the cause of colic.[15] The evidence that supported food allergy as a cause of infantile colic consisted of the increased rate of atopic disorders in infants (histologic or humoral changes) and reactions to antigens in dietary trials. Careful scrutiny of these studies show that either through selectivity of the most severe of colicky infants for their study, or careful study of methods (nonblinding of subjects nor researchers), there was little difference in the experimental and control groups when the size, severity of symptoms, and methods were taken into account.[20] A study by Lust and colleagues on exclusively breast-fed infants with colic found there was an increased association of colicky symptoms with infants whose mothers ingested one or more cruciferous vegetables (broccoli, brussels sprouts, cabbage, cauliflower), cow's milk, onion, or chocolate the week prior to data collection, although a dose response could not be established between frequency of maternal intake and symptoms of colic.[19]

However, among the dietary studies, there does appear to be a subset of infants where the introduction of bovine whey formula has been implicated as a cause of colic.[20] Cow's milk contains protein, which is about 80% casein and 20% whey, whereas breastmilk is approximately 60% whey and 40% casein.[2] This and subsequent studies on infants with severe colic started on a hypoallergenic-formula milk (a casein hydrosylated formula such as Nutramigen, Pregestimil, and Alimentum) have implicated cow's milk formula as a potential cause in this subset of infants.[2,7,18,20]

Evidence of intestinal hypermotility as a cause of infantile colic comes from several sources.[20] One radiologic study showed increased gastric emptying in a small set of colicky infants. This study included not only colicky infants, but infants with other gastrointestinal and feeding problems.[20] A study by Jorup in infants older than 3 months of age with dyspepsia and abdominal pain found colonic hyperperistalisis and increased rectal pressure, which responded to anticholinergics.[9] There have also been medication trials when dicyclomine (an anticholinergic drug that is believed to work by decreasing intestinal spasm by smooth muscle relaxation) has been effective in treating infantile colic.[20]

The presence of GI tract hormones such as motilin have been reported to be observed in infants with colic. Motilin is a hormone that stimulates gastric emptying and peristalsis—this produces decreased small bowel transit time and supports the hyperperistalisis theory. Other studies examining cord blood on the first day of life showed higher levels of motilin from the cord blood of infants who later went on to develop colic.[20] Loeth and associates showed that feeding colicky infants human milk, between 1-3 months of age, produces higher serum levels of "α-lactalbumin ("α-LA).[16,17] They conclude that there is increased macromolecular absorption in infants with colic. Whether this increased absorption is the cause or the effect of the infant having colic is still a question.[16,17,20]

Nongastroenterological Causes

If we look at crying as a normal behavior for an infant, we should see a Gaussian distribution of infants, from those who cry very little (the good babies), to those who cry constantly. Colic might then be viewed as an extreme in the spectrum of the normal variability of crying.[7,20] This theory at least concurs with the fact that colicky infants are normal by history and physical examination, and that this syndrome is equally distributed between breast-fed and bottle-fed infants.[20]

Colic could also be viewed as a cultural problem, as it has been found to be more prevalent in Western cultures. In many societies (eg, West African, Kung San from Korea, and Manali), infant-carrying styles differ so that infants can spend most of their day attached to their mother; they also sleep at night with their parents. Excessive crying from infantile colic is much less prevalent in these cultures.[13] It should be noted that these societies also have different social structures, which allow the infant more exposure to extended family members who can provided added support and child care relief for parents.[13]

Another way to view colic is as a variant of the normal infant personality. The colicky infant can be viewed as the high-maintenance newborn with an "attitude," or a more sensitive temperament.[7] These are infants that are reactive to small changes in their environment who show hypertonicity of body and spirit.[7] The trouble with this theory is that the colicky infant in the evening can be normal and angelic during the day, which discounts the personality variant as a major cause of colic. Also, blaming the vic-

tim (the infant in this case) for this disorder can set up the parent against the child in a battle for who will control the peace (or lack thereof) in the home at night.[7]

Atypical parenting as a cause for colic refers to the myth that colic may be caused by an unfavorable emotional environment created by inexperienced, anxious, or hostile caregivers. If inexperienced and high-strung parents were the cause of colic, you would expect this condition to be more common in first-born children, when most parents are more anxious about child rearing and their skills to cope with this challenging condition. Family stress, tension, and anxiety is more likely to be the result of living with a colicky infant, and not the cause of the syndrome.[4,7]

Smoking has also been investigated as a cause of infantile colic. In a recent study investigating a relationship between feeding type, maternal smoking, and infantile colic, Reijneveld and associates showed that the prevalence of colic was 2 times greater among infants whose mothers smoked.[23]

Treatment Strategies

Making the appropriate diagnosis is only the beginning of the work for the tired, stressed, and bewildered family. The goal of therapy is to get the family through this difficult period with the family members' sanity and self esteem intact. Your medical therapy of infantile colic should consist of reassurance, encouragement, development of treatment strategies with the parents, and the provision of any necessary medical information.

There are several reasons in the literature concerning the ineffectiveness of standard treatment modalities for infantile colic and include the following:

- Colic is hard to define.
- There are no clear diagnostic criteria.
- It is a diagnosis of exclusion.
- There appears to be a spectrum to this syndrome.

The above can account for the variations of success treating infants with colic.

Diet

Changing from breast milk to formula, or switching formulas for the treatment of infantile colic is rarely effective in eliminating the symptoms of this syndrome.

This said, it is still the No. 1 treatment for this condition. It is usually tried before parents come to the PCP's office in their exhausted and frustrated state. Colic occurs equally in breast-fed and formula-fed babies. Although many mothers stop nursing due to lack of support, anxiety, and guilt, there is *no* scientific reason to stop breast feeding with a colicky infant.[1] Nursing periods are the time of day when these infants do not cry. Breast feeding mothers may exclude or limit dietary intake of cruciferous vegetables, cow's milk, onion, or chocolate for a short period of time to see whether crying diminishes.[7,21]

Symptoms of cow's milk allergy usually start in the first 6 months of life—the incidence varies from 0.3% to 10% of infants.[2] Although food allergy can manifest as abdominal pain and irritability, it can also be accompanied by vomiting, diarrhea, intestinal bleeding, constipation, and poor weight gain or weight loss, which are *not* usual symptoms of infantile colic.[2,18] Although irritability is eliminated by removing cow's milk from the diet of allergic infants, sleeplessness may persists after changing to a hydrolyzed formula.[2]

Some techniques are helpful in feeding infants with colic. For bottle-feeding infants, holding infants in a more vertical position (such as sitting) and using the correct bottle and nipple size for the infant's age are beneficial. Curved bottles, which accommodate the sitting position, and bottles with collapsible bags are useful in decreasing air swallowing. Eliminating cow's milk from the infant's diet can be helpful in those colicky infants with cow's milk-protein intolerance or allergy. Burping in the upright position with the baby held over the shoulder or in the chin grasp position while sitting after ingesting every 1-2 oz of formula or every 5-10 minutes of nursing is also helpful for eliminating air.[1]

Medications

From a historical point of view, the best known nonprescription drug commonly used for infantile colic was alcohol. It was in a number of over-the-counter preparations and home remedies. Use of alcohol should be discouraged even though it has been used for a long time. Proper dosing for infants is hard to accomplish, whereas side effects and poisoning are easily achievable consequences.

It should be noted that a number of our colleagues do not favor drug treatment (specifically medications that can cause drowsiness) for colic. Infancy is thought to be a time in life where a great deal of learning through use of the 5 senses and information storage takes place. Alert infants, even when crying, are more likely to be looking, listening, smelling, tasting, and touching than their somnolent counterparts.

Herbal remedies in the form of teas containing chamomile and other herbs have been helpful for infants and their nursing mothers. Before recommending herbal remedies, it is a good idea for you to investigate recommended dosages for infants, any possible side effects or interactions, and several different brands of these therapies, as quality and potency can vary.[7,21]

Dicyclomine hydrochloride (Bentyl) is an anticholinergic, antispasmodic drug that has been shown to be effective for this condition. It causes smooth muscle relaxation in the colon but may also have some systemic or CNS effects properties that make it useful for the management of these symptoms.[13,18,21] However, there have been reports of apnea, seizures, coma, and death reported with use of this medication, so I now consider this contraindicated for treating colic.[13,21]

Simethicone is a chemically inert drug commonly used to eliminate symptoms from increased intestinal gas.[13,21] It works by changing the surface tension on the gas bubbles, which allows them to release gas for easier expul-

sion. Unfortunately, 2 out of 3 studies showed no difference when Simethicone was compared to placebo for the treatment of infantile colic. Also, the parents' subjective rating of this medication during the studies showed no statistically significant decrease in symptoms during the treatment.[13]

Chloral hydrate is a powerful, hypnotic sedative and anticonvulsent that has a calming effect on infants. It also has potential for side effects such as vomiting, irritation of the gastrointestinal tract, and drowsiness, which make it an undesirable medication to use in this condition, unless most of the colicky symptoms happen during the night when the rest of the family is attempting to sleep.[7,21] If symptoms occur regularly at the same time every evening, a dose of the medication can then be given nightly 15-30 minutes before symptoms usually commence. After a few weeks, the medication can be discontinued to see whether the symptoms return.

Phenobarbital is a barbiturate with antispasmodic properties. It has been used separately or in combination with Bentyl (Levsin). It causes CNS depression and drowsiness—an undesirable side effect in infants who have so much to observe and learn in their first few months of life. In low doses, it can increase pain perceptions and reactions (ie, crying).[21]

Alternative/Integrative Medicine

Chiropractic and homeopathic practitioners have also been sought out by frustrated parents for the treatment of colic. Through spinal adjustment and homeopathic cramp remedies, they have had their successes in some infants with colic. Reiki treatments have also been used for the treatment of colic. This involves hiring a Reiki practitioner to open natural healing energy, which allows the infant to relax. Physical and occupational therapy have also been used for the treatment of this syndrome.[21]

Physical Methods

In normal infants, auditory, visual, tactile, and temperature stimulation have a pacifying effect. Rhythmic movements such as rocking, swinging, riding in a car, experiencing washing machine or dryer turbulence (from the outside of these appliances), and other vestibular-proprioceptive stimulating activities have been found to sooth even distressed infants with colic.[1,6,13,21]

Infants with skin-to-skin contact with their mothers cry significantly less than infants left alone in the crib.[13] However, studies using closer infant-carrying methods for the treatment of infantile colic (eg, swaddling, holding positions that allow increased abdominal pressure, and supplemental carrying) have had varying results when compared with standard therapy.[1,4,7,13] The use of warm baths, warm water bottles on the abdomen, and increased crying responsiveness (simulating traditional cultures) have also been disappointing as treatment for this condition. Nonetheless, holding infants during colicky spells is benign and, although far from curative, can attenuate symptoms and ameliorate infant and parental anxiety.[1]

Massage of the infant's whole body or abdomen with or without scented oils, and the cycling of the infant's legs have been recommended for colic. Little research about the effectiveness of this therapy has been conducted; however, repetitive motions may be relaxing to the infant and the hands-on involvement of the caregiver may have a calming effect for both parent and child.

Counseling

Parents and other caregivers of these infants are usually anxious, worried, feel helpless, and perhaps even guilty about the care they are giving to their infants.[1,6,11] They need support and reassurance so they can go home with their colicky infant, and care for them lovingly for the next few months. Parents need to be reassured that the infant is healthy, gaining weight, and showing no signs of illness. They need to know that they are not the cause of their infant's condition, that it is self limited, benign, and will go away in a few months. They need to be counseled on strategies for treating this syndrome. They need support in order to continue to give loving care to this infant who appears not to respond to their care.

As discussed previously, extended family members can be a great asset in the treatment of this condition. They can also be a source of anxiety, guilt, and frustration if they are discordant with the treatment plan of the parents and the PCP. A call to any concerned family members who could not be present for the initial examination will go far to prevent family discord. The absent family members can be assured that you are a caring and concerned physician, and that their observations and opinions were important enough to you for you to communicate with them. It also eliminates any worry or guilt they may have that enough information was not given to the health care providers in order to make an adequate diagnosis because they were unable to attend the visit.[1,4,6,11]

Caretaker burnout is also a concern—a daily nap or an outing away from home for both parents if possible without the baby is very therapeutic. The babysitter has to be mature and capable to take care of the newborn with this condition. Parents also need help prioritizing which tasks are really necessary to be completed before nightfall. With little quality time available due to episodes of crying and increased stress in the home, it is important to let them know that for the first 3-4 months of the infant's life, it is OK to have flawed housekeeping and cooking responsibilities. This should give the parents a little time to catch up with needed sleep, relaxation, and recreation.[1,4,6,11,18] Counseling, education, empathy, reassurance, and support for the caregivers and the families of colicky infants is the mainstay of therapy.

Colicky infants also need behavioral therapy in the form of assisting them to regulate their own behavior by avoidance of overstimulation.[12] Parents should attempt to

train them to recognize the day-night, wake-sleep cycle. Regulation of the infant's environment so that it is a predictable pattern for the infant will be helpful.[10,11,12] Touch in the form of skin-to-skin contact while feeding or during massage by holding the infant is also an important feature in treatment.

Finally, parents should know that although these methods have been effective in the past with other colicky infants, they will have to experiment and choose the ones that work best for the colicky infant in their household.

Complications

Although colic is thought to be a benign and self-limited condition, intensive, unremitting, and inconsolable crying is profoundly disturbing to the main caregiver of the infant and the entire household. This can be a source of family disruption, which has a significant effect on the parent-infant interaction.[10]

A study by Keefe, which looked into the mother-child relationship in colicky infants vs. their normal controls, showed that mothers of infants with colic were different from their normal counterparts. They demonstrated less social and emotional growth-fostering behaviors, and less infant responsiveness while feeding. These parents also reported that expectations of their infants and themselves changed significantly from their prebirth predictions. They also expressed feeling distressed, inadequate, concerned, and frustrated. These expressions and behaviors improved over time.[10]

Long-term studies of families effected by colic show that there are differences in colic and noncolic surviving families. Post-colic infants were more likely to have sleep disorders.[4] Infants often have an irregular sleeping pattern and problems with feedings.[1,8,13,26] Although family mood was improved after the newborn period ended, families with severe colic had more difficulties with communication, conflict resolution, they were less satisfied, and less empathetic than those with moderate colic, or normal crying infants.[10,22]

Certainly, parents fatigued from having many consecutive nights of interrupted sleep may become irritable and less responsive to each other's needs. Most parents of colicky infants report a disruption of their marital relationship during the colicky period.[14] Disruption of evening meals, family time together, and sexual relations are a few of the problem areas reported by the parents of colicky infants.[14] Mothers have reported jealousy over the father's ability to escape the symptoms of colic by going to work.[14] Fathers also can feel left out, inept, and emotionally drained in their infant encounters. Siblings are also effected by their colicky siblings as the loud and misbehaving infant gets all of the attention.

Some recent studies have shown a higher incidence than previously expected of maternal fantasies of aggression, and even infanticide in taking care of infants with colic.[14] In a study on child abuse in children younger than 1 year of age, excessive crying was cited by the parents as the reason for the abusive behavior.[11] All of these infants should have a complete examination, which includes looking for signs of physical abuse. Signs of grab marks, ecchymoses, extremity immobilization, and trauma to the lips from jamming a pacifier or a bottle into the infants mouth are very suggestive of physical abuse.[4,14]

Urgent or repeated phone calls after your initial evaluation and education session may be a sign that caregivers are being overwhelmed. This should trigger an office visit to reevaluate the situation. During the waiting-room period, the physician should take time to evaluate the family behavior and interactions with the infant. Inquiry into the physical and emotional health of the parents and other family members can open the discussion into how they can be supported while giving care to this high-maintenance infant. Behavioral management, education, and counseling and the most important elements of treatment.[10,11,12,14]

Conclusion

Infantile colic, although viewed as a benign self-limited condition of the first few months of life, can have a devastating effect of the health and well being of the family that has to live with this condition. A PCP with good listening skills who addresses the family in a caring and empathetic manner can go a long way in helping the family survive this infant's condition without prolonged sequella or complications. Education, empathy, support, and reassurance will decrease the anxiety and guilt expe-

rienced by this family, provide a management plan, and allow the family to live with this problem until it resolves itself with time.[1,10,11,12]

Advice to Parents

Parents need to be reassured that:

- a baby with colic is a normal and health infant.
- this condition will pass in 3-4 months.
- many things can be done to treat or diminish the symptoms of colic.
- parents usually need more help and support than the infant with this condition.
- taking rest breaks, spending time without the baby, and delegating other household responsibilities can be helpful.
- baby sitters need to be prepared, competent, and mature.
- the mother should not stop breast feeding! Changing the baby's diet rarely cures infantile colic.

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Acknowledgments

The author would like to thank Ed Erde, Professor, Department of Family Medicine, UMDNJ-SOM, for his guidance, motivation, and indefatigable friendship during the completion of this article.

Physician CME Questions

24. Colic is a syndrome that affects:
    a. West African infants.
    b. infants aged 6 months to 1 year of age.
    c. children from families with a history of colitis.
    d. infants 2 weeks to 4 months of age.
    e. the central nervous system.

25. Symptoms consist of:
    a. high-pitched crying for more than 3 hours a day and for more than 3 days a week lasting more than 3 weeks.
    b. vomiting, diarrhea, and fever.
    c. seizures, weight loss, and dehydration.
    d. cough, fever, and shortness of breath.

26. Physical findings include:
    a. increased pulse, temperature, and respiration rate.
    b. abnormal stool culture.

c. electrolyte imbalance.
d. abnormal UA.
e. a normal examination.

27. Treatment of infantile colic include which one of the following?
    a. Counseling the family
    b. Stop breast feeding and switch to a nonlactose formula
    c. Treating the underlying ear infection
    d. Diligent housekeeping

28. The differential diagnosis of infantile colic include:
    a. infection of the ear, urinary tract, or central nervous system.
    b. cow's milk allergy.
    c. sleep disorder.
    d. intestinal gas.
    e. All of the above

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