The Crying Infant

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Crying is a part of normal human behavior. Infants cry for a variety of reasons including the need for attention, hunger, discomfort, or pain. However, when the amount of crying is perceived to be excessive or without discernable cause, it can be the cause of much parental as well as physician anxiety. During the first 4 months of an infant’s life, excessive crying has been one of the problems most commonly reported by mothers [1–3]. The prevalence of excessive crying in infants has been estimated to be between 1.5\% and 40\% [4–7]. Among those 1 to 6 months of age, 1-month-old infants appear to have the highest prevalence [5].

Crying in infants can have a strong impact on both the families and the medical system that supports them. Crying and irritability are among the most common reasons that families seek medical attention during a child’s first months of life and therefore it is a frequent presenting complaint for pediatricians and emergency physicians. A study from the United Kingdom has estimated an annual cost of $108 million to the national health system related to the care of infants with crying and difficulty sleeping in the first 12 weeks of life alone [8]. It is an important cause of maternal anxiety and stress, and is strongly associated with maternal depression [9–13]. Infant crying has also contributed to the discontinuation of breast-feeding [2]. Moreover, not only is the relationship between a mother and infant often subjected to stress in such situations, the entire family dynamic including interactions between the infant and father and that between the two parents can be negatively affected [10,14]. In the worst of cases, it has been implicated as one of the inciting factors in physical violence and even infant death [9,15,16].

One of the challenges for every physician presented with a crying or irritable infant lies in discriminating between benign and organic causes for...
crying. Because of the commonality and seeming banality of the problem, the chief complaint of “crying” is at times greeted by the physician with disdain. While it may be tempting to dismiss these patients and assign a pre-emptory diagnosis of colic after a cursory history and physical exam, they are better served when each case is looked upon as a clinical challenge rather than as an annoyance. It is also an opportunity to educate and counsel parents in regard to the care of their infant. Conversely, excessive caution or fear of “missing” a diagnosis may result in unnecessary and overly invasive tests. Therefore, caring for such patients requires a fine balance.

Crying: how much is normal?

The literature on excessive crying is considerable. For the larger part, the term has been used to describe crying behavior in infants resulting from nonorganic disease. It may denote duration, frequency, and intensity of crying, and has been used interchangeably with “persistent crying,” “infantile colic,” and “paroxysmal fussing.” Before discussing excessive crying in infants, however, it is helpful to understand their usual crying behavior. Fortunately, this has been previously illustrated in a number of studies.

In 1962 Brazelton [17] delineated the crying pattern in infants based on prospective data from 80 infants from birth through 12 weeks of age. He found that infants in their second week of life cried and fussed for a median of 1.75 hours (30 minutes in the upper quartile and 20 minutes in the lower quartile). From there, it increased gradually to a peak median of 2.75 hours at 6 weeks of age, after which there was a decline in the amount of crying. At 3 weeks of age the majority of crying was concentrated in the hours between 6 and 11 PM with smaller concentrations between 4 to 7 AM and 9 to 11 AM. At 6 weeks of age crying occurred more at the end of the day between 3 PM and 12 AM with a smaller peak in the early morning. By 10 weeks of age infants were crying to a lesser extent and mostly between the hours of 6 AM to 12 PM and 5 PM to 11 PM.

Subsequent studies that described crying beyond 12 weeks of age have supported and supplemented Brazelton’s original work. Crying in infants has often been described using a behavioral or crying curve characterized by a peak at 2 months of age and a decline thereafter until about 4 months after which it remains relatively steady [17–20]. There appears to be a circadian pattern in which crying is concentrated most in the late afternoon and evening. This decreases by the middle of the first year, and after 9 months of age crying at night becomes more common [18,19]. It is important to note that despite observed trends, there does exist considerable variability of crying between infants as well as day-to-day fluctuations of crying in each infant [18,21].

Perhaps one of the earliest studies that addressed excessive crying was that by Illingworth [22] in 1954 in which he described 50 infants in the first
3 months of life with “rhythmic attacks of screaming.” In finely illustrative terms, he described the child thus: “his face flushes, his brow furrows, and then he draws his legs up, clenches his fists and emits piercing, high-pitched screams, which do not stop when he is picked up, continuing unabated in his mother’s arms.” Such episodes lasted 5 or more minutes, occurred predominantly in the evenings, and had no clear inciting cause. Illingworth called this phenomenon “three months’ colic” because it improved by the time a child reached 3 months of age.

Contemporaries of Illingworth, Wessel and colleagues [23] used the phrase “paroxysmal fussing” to describe a similar phenomenon in 98 infants. In what has come to be known as the “rule of threes,” they defined a fussy infant as one who cried or fussed for a total of more than 3 hours a day occurring on more than 3 days a week. The infants were, furthermore, divided into one of three groups: (1) contented, (2) paroxysmal fussers, and (3) seriously fussy. Contented infants were those who did not meet the criteria outlined above. Seriously fussy infants were those whose paroxysmal fussing episodes continued for more than 3 weeks. As with Illingworth, Wessel’s group found that the episodes, in most cases, subsided by the end of the second month of life.

While Wessel’s designation of the amount of crying that constitutes excessive has become the most commonly accepted standard, the literature on crying has not always been consistent. Numerous studies have used variations on that definition, which has made it somewhat problematic to interpret the data as a whole. Different definitions have resulted in study groups composed of dissimilar infants between and among studies; this makes it difficult to compare estimations of prevalence as well as the cause and treatment of excessive crying [5]. Similarly, it may be difficult to consistently identify characteristics of at-risk infants [24].

When confronted with a crying infant in the emergency department, while it is helpful to understand the common pattern and distribution of crying, it is important to consider each child individually. Bouts of crying of several weeks’ or months’ duration with relatively stable frequency may be more reassuring than that which started much more recently even if the latter conforms better to the “normal” infant crying pattern. One may more comfortably attribute the former to benign crying, while the latter may require more in-depth investigation. While the crying curve is helpful in the understanding of infant development, it is meant be applied within the context of a case.

Colic

Colic is a well-known syndrome of excessive crying. Beyond that, the exact definition encompassing etiology as well as possible treatments varies considerably. The term colic itself is perhaps a misnomer. It is a derivation of the
Greek word for colon, and, as such, implies gastrointestinal (GI) dysfunction as the underlying cause. In fact, GI dysfunction is only one of several theories that have been presented over the years to explain the colic syndrome. These theories span physiological, psychological, and behavioral foundations.

Some of the earliest and more popular explanations for colic involve cow’s milk protein allergy, malabsorption, and gastrointestinal dysmotility. In 1901 Zahorsky [25] reported that “proteids” found in breast milk caused violent peristalsis in the gastrointestinal tracts of colicky infants. Unfortunately, studies that have examined gastrointestinal dysfunction as the source of colic have often been plagued with inadequate sample numbers and faulty methodology [26,27]. A number of studies have demonstrated that crying decreased in formula-fed infants when cow’s milk protein allergy was eliminated from their diets [28–30]. However, as Treen [26] has pointed out, some of these studies were not blinded and lacked adequate controls, while others preselected a subgroup consisting of infants with the most severe degree of crying who had already failed standard counseling and medication trials. The data on elimination of cow’s milk from the mothers’ diets in breast-fed babies have yielded mixed results [31–33].

Malabsorption has been thought to be a possible cause for colic through the production of excess colonic gas, abdominal cramping, and discomfort. However, this has not borne out in all studies. In one prospective study of 56 infants with colic, stool examinations for pH and reducing substances were normal [34]. In another study, breath hydrogen production was measured in 122 healthy infants after feedings containing lactose [35]. The group of colicky infants had more numbers of positive breath tests compared with the noncolicky infants, and failure to produce hydrogen gas throughout the breath test was more frequent in the latter group. However, there was considerable overlap in the hydrogen excretion values between groups. Ultimately, malabsorption may account only for a small subset of infants with colic.

Gastroesophageal reflux disease (GERD) as a cause for colic is a common conception held by both health care providers and parents [36]. One study with 51 infants admitted to the hospital with crying or irritability found that the most common diagnosis previously assigned to them was gastroesophageal reflux disease [37]. The data on this topic, however, has been mixed. In a study of 26 infants with colic of more than 4 weeks’ duration that was considered severe enough to prompt referral to a pediatric gastroenterology clinic, pathological GERD was found in 16 (61.5%) using pH-metry [38]. All of those infants experienced a reduction in crying 2 weeks after institution of treatment. Of note, however, the remaining infants without GERD also experienced a resolution of their colic over a 4- to 6-week period. One may question whether the patients who received treatment might have improved even without intervention. In addition, because the median age of the infants in the group was 4.8 months, a number of them had crying that persisted beyond the time when the average infant’s crying
has abated. Thus, this was a group preselected for the most severe patients, and may not be an accurate reflection of the population of colicky infants as a whole. A review of the relationship between colic and GERD found that there was little evidence to support the connection, and furthermore, that there was poor correlation between irritability and episodes of reflux on pH probe studies [36].

Although gastrointestinal disturbances cannot fully account for the colicky behavior in many infants, they might explain crying and irritability in at least a subgroup of patients. The diagnosis can be considered when the history or physical examination is suggestive, as for example, when there are feeding difficulties, excessive emesis, diarrhea, constipation, or mucous or blood in the stools [26,36,39]. Excessive crying beyond 3 months of age or worsening of crying, although this has been shown to persist into the fifth month of life in otherwise healthy infants, should also raise suspicion of gastrointestinal or other causes of irritability [4,26].

An extensive body of literature has examined infant crying in terms of development and temperament. Barr described four distinct clinical crying syndromes in the first year of life, namely: (1) colic, (2) persistent mother-infant distress syndrome, (3) the temperamentally difficult infant, and (4) the dysregulated infant [40]. Colic, in this view, should be regarded as a manifestation of normal development. Furthermore, if crying syndromes were viewed in terms of responsivity (positive or negative), reactivity (the intensity, threshold, and timing of the response), and regulation (inhibition of the response), colic could be described by increased responsivity and reactivity, and decreased regulation. The persistent mother-infant distress syndrome refers to infants whose crying peaks at 2 months and worsens or fails to decline thereafter. These infants may have additional characteristics including feeding and sleeping disturbances, and familial discord [14,40]. The temperamentally difficult infant has been described as having a predisposition to negative responsivity (crying), and high intensity and low distractibility on the Early Infancy Temperament Scale [40,41]. Finally, dysregulated infants are thought to have central dysfunction and usually present in the latter part of the first year of life with disturbances in multiple behavioral domains including affect, feeding, and motor activity [40]. Viewed in this manner, one can conclude that the crying syndromes can and do overlap.

In the past, one of the theories offered to explain colic was that of the indifferent or aloof mother [21]. This view serves neither the interests of the mother nor the child and has fortunately been discredited in recent years. St. James-Roberts and colleagues [42] compared the caretaking styles of mothers of 67 persistent criers at 6 weeks of age who cried 3 or more hours a day with 53 moderate criers and 35 evening criers who cried less than 3 hours a day in total. They found that there was no significant difference in maternal sensitivity or affection between the groups. The studies examining the possible effects of maternal care on crying in infants 3 months and
older have been mixed [43,44]. However, at that age when colicky crying has started to decline, excessive crying may have different implications.

Colic may best be viewed as a syndrome consisting of common symptoms rather than a specific disease entity. It consists of the timing and duration described above; that is, crying for more than 3 hours a day for 3 days a week for 3 or more weeks, which peaks at about 6 weeks of age and starts to decline at about 3 months of age. These crying bouts are characterized by their failure to abate with the usual soothing methods such as feeding, holding, or rocking. Many parents may feel that their child is in pain because of the inconsolability and characteristic posture adopted by these infants consisting of drawing up their legs, furrowing their brows, and screaming. However, they occur by definition in healthy well-fed infants who are growing and developing appropriately and appear “normal” between the bouts.

**Colic treatments**

Once the diagnosis of colic has been made, one must contend with prescribing treatment and giving the parents suggestions on ways with which to deal with their infant’s crying. This is neither straightforward nor always successful. The methods that have been prescribed to control infantile colic thus far have included both medical treatment and behavioral modifications. No one approach works consistently for every infant. The process of trial and error may be discouraging and frustrating for both the parents and their health care providers. In treating patients with colic, it is perhaps just as important to offer support to the parents as it is to find ways to assuage the infant’s crying.

A number of medical treatments have been examined regarding their efficacy in reducing crying in colic. Simethicone is one agent commonly used in the treatment of infantile colic, although its effectiveness has not been fully supported. It is a defoaming agent that is thought to accelerate the passage of gas in the gastrointestinal tract. In one randomized, double-blind, placebo-controlled multicenter trial with 83 infants ranging from 2 to 8 weeks of age, simethicone was no more effective than placebo [45]. A systemic review that included three randomized controlled trials found that only one showed possible benefit, but noted that the authors did not elucidate their definition of colic in that study [46]. A second review found that although the use of simethicone was not supported by good quality trials, it has no reported adverse effects and is widely used based upon common consensus [47].

Dicyclomine and dicycloverine are anticholinergic medications that are thought to relieve crying in colic through their actions as smooth muscle antispasmodics. They have been found to be effective treatments in a number of randomized controlled trials [46,48]. However, because of reported adverse events, the manufacturer has contraindicated their use in infants younger than 6 months and they are no longer indicated as treatments for
infantile colic. The most frequently reported adverse events were drowsiness, constipation, and diarrhea. The most serious events, occurring most commonly in infants younger than 7 weeks, included shortness of breath, apnea, syncope, seizures, hypotonia, and coma [49].

Sucrose has been studied in the treatment of infantile colic because it is thought to cause release of endogenous opioids providing an analgesic effect in infants [50]. One double-blind double-crossover study examining the effect of 12% sucrose on 19 infants found that 12 had a positive response, although this only lasted for 30 minutes to an hour [51]. A randomized controlled trial using 48% sucrose with 19 colicky infants similarly showed that the response to sucrose was short-lived; in this case only up to 3 minutes [52].

Several studies in which lactase enzyme was introduced into the milk of infants with colic have not shown significant reductions in crying [53,54]. Miller and colleagues [54] conducted a randomized controlled trial with 15 colicky breast-fed infants and found that lactase did no better than placebo in reducing duration of crying. In a second small double-blind crossover study with 10 infants fed both breast milk and cow’s milk formula, the duration and severity of their colic was not significantly different when they received milk treated with lactase [53]. One double-blind randomized placebo-controlled crossover trial with 53 infants did find that crying time was reduced in 26% of infants who received lactase, although the difference was not significant [55]. A recent review that included four randomized controlled trials determined that the evidence was such that one cannot draw firm conclusions [47].

A number of dietary changes with the intent to eliminate cow’s milk protein have been proposed as interventions for colic or crying. One of the most prevalent is perhaps the use of soy-based formulas as opposed to cow’s milk–based formulas. A survey of 1803 mothers in Israel found that 10.4% of infants were given soy-based formulas at 2 months of age, 20.4% at 4 months of age, and 31.5% of infants at 12 months of age [56]. Colic ranked among the main symptoms that triggered medical personnel and/or the mothers to initiate the change to a soy-based formula. One systemic review with three trials found that the substitution of a soy-based formula for cow’s milk formula had a small favorable effect in infantile colic [48]; however, the significance disappeared when results were calculated using only the trials deemed to be methodologically sound. A second systemic review found two randomized controlled trials that examined the efficacy of soy formula in reducing symptoms of colic in bottle-fed infants [46]. Both studies showed a decrease in symptoms, but the methodology was found to be flawed. One study enrolled infants admitted to the hospital for colic, selecting a population much different from the majority seen in the outpatient setting. Both studies were thought to have inadequate blinding. A more recent review that included the same trials concluded that although no harms were reported in either, the evidence was of insufficient quality to determine the benefit of soy-based formula in infantile colic [47].
Some studies have addressed the efficacy of a low allergen diet in mothers of breast-feeding infants in reducing symptoms of colic. In one double-blind randomized placebo-controlled study, Hill and colleagues [57] looked at the 77 breast-fed and 38 bottle-fed infants. Mothers of the breast-fed infants were randomized to a low allergen diet free of milk, egg, wheat, and nut, or to a control diet free of artificial color, preservatives, and additives. Bottle-fed infants received either a hypoallergenic casein hydrolysate formula or a control cow’s milk formula. When results of the two groups were combined in analysis, 61% of infants randomized to the low allergen or hypoallergenic feeds experienced more than 25% reduction in distress versus 43% of those on the control diets. In comparing the results between the bottle-fed and breast-fed groups, the investigators did not find a significant difference. Evans and colleagues [32] performed another small placebo-controlled double-blind randomized crossover trial with 20 exclusively breast-fed infants. They determined that eliminating cow’s milk from the maternal diet did not ameliorate the distress in colic except in infants whose mothers had a history of atopy. A third more recent randomized controlled trial with 90 colicky infants found a significant absolute risk reduction of 37% in cry/fuss duration in 47 infants whose mothers were randomized to a low-allergen diet free of dairy products, soy, wheat, eggs, peanuts, tree nuts, and fish compared with the 43 infants whose mothers were randomized to the control diet [58]. Although there is some conflicting evidence, overall, the studies suggest that some therapeutic benefit may be derived in colicky breast-fed infants when their mothers maintain a low-allergen diet.

Hypoallergenic formulas including casein hydrolysate and whey hydrolysate formulas are potentially promising treatments for colic [46–48]. In Hill and colleagues’ [57] study comparing casein hydrolysate formula to cow’s milk formula, the infants randomized to the former group did significantly better in terms of reduction of distress. However, there were only 38 bottle-fed infants in the study, and the results were pooled with those of breast-fed infants. A second double-blind crossover randomized study with 17 infants evaluated the effects of alternating casein hydrolysate and cow’s milk formula on colic symptoms [59]. Although symptoms were significantly reduced when the infants were on the casein hydrolysate formula, the effects diminished over time and there was no difference between groups by the third change. In addition, eight infants dropped out of the study before completion. Lucassen and colleagues [60] compared whey hydrolysate formula to cow’s milk formula in a double-blind, randomized trial with 43 infants with colic. Infants in the first group were found to have an average in decreased crying time of 63 minutes compared with those receiving cow’s milk formula. However, blinding may have been inadequate.

A number of herbal remedies have been used anecdotally in the treatment of colic. One study comparing the effects of a tea containing chamomile, vervain, licorice, fennel, and balm-milk to placebo found that after 7 days of treatment 57% of infants in the active treatment group no longer met
Wessel’s criteria for colic versus 27% of those in the placebo group [61]. Long-term effects were not studied. In addition, the average amount of tea consumed by infants in the study was 32 mL/kg/day which leads to concerns about nutritional deficiencies should the amount of milk consumed decrease accordingly. No adverse effects were reported in this study. However, not all herbal remedies may be considered safe. In particular, star anise is a spice used among the Caribbean and Latino populations to make tea for the treatment of colic. Chinese star anise is commonly viewed as safe, although neurological symptoms have been seen with higher doses [62]. The closely related Japanese star anise, however, has been reported to cause both gastrointestinal and neurological toxicities including vomiting, jitteriness, myoclonus or clonus, nystagmus, and seizures [62,63].

Along with medical remedies and dietary changes, parents are oftentimes advised to initiate behavioral interventions for their colicky infants. These include increased infant carrying, car rides, decreasing stimulation, and infant swaddling. Two systemic reviews with two randomized control trials found that there was no reduction in symptoms with increased infant carrying [46,48]. One randomized controlled trial showed that the use of a car ride simulator was no better than counseling and reassurance in reducing the amount of infant crying or maternal anxiety [64]. Two systemic reviews found one randomized controlled trial that addressed the question of whether or not decreasing stimulation effectively reduces the symptoms of colic [46,48]. In this study, 93% of infants in the treatment group showed improvement compared with 50% in the control group [65]. However, the study had methodological weaknesses including a subjective case definition that precludes one from drawing firm conclusions [46–48]. A recent randomized controlled trial evaluated the added effect of swaddling to nurse support and stimuli reduction on excessive infant crying [66]. Swaddling was found to have no added benefit for the group as a whole. However, the subgroup of infants younger than 8 weeks did appear to benefit although the results were modest with a crying time reduction of 12 minutes per 24 hours.

Pathological crying

Organic diseases account for less than 5% of infants presenting with excessive crying [67]; however, the importance of distinguishing crying due to pathologic causes from nonpathological causes cannot be understated. In addition, in the face of an actively wailing infant and his or her strained parent(s), the examination room setting can often be tense. Because the complaint of crying is so nonspecific, the differential diagnosis is extensive and may be somewhat overwhelming. The authors find it helpful to use a systems-based approach.

The importance of a thorough history and physical examination cannot be overemphasized. In a prospective study of 56 infants presenting to the
Emergency Department with ages ranging from 4 days to 24 months (median age 3.5 months), Poole [68] found that 61% had diagnoses that were considered serious. The history provided clues that aided in the diagnoses in 20% of these patients, while the physical examination provided the diagnoses in 41% and provided clues leading to the diagnoses in 13%. The remaining 24% of infants with serious conditions continued to cry excessively after the initial assessment. Of note, patients were excluded from the study when they had fever or history of fever, symptoms of acute illness within the past 72 hours, or history of a previously diagnosed disease that could predispose them to bouts of pain or crying including colic, sickle cell anemia, and ventriculoperitoneal shunt.

In addition to the usual questions concerning onset, duration, and frequency of crying, and associated symptoms, the initial history should include a thorough review of systems, birth history, developmental history, past medical history, medications, and allergies. A history of recent immunizations should be included as well. Persistent crying associated with painful local reactions has been reported following administration the diphtheria-tetanus-pertussis vaccine [69]. The infant should be undressed to allow a complete exam. A thorough history and physical examination will go a long way in helping to sort out the possibilities. Box 1 lists some of the more common causes of crying in infants.

*Head, eyes, ears, nose, throat*

The head and scalp should be palpated carefully. Soft tissue swelling, tenderness, or skull depression suggest trauma and should prompt radiological testing especially when the injury is unexplained or the history is inconsistent. A bulging fontanelle raises concerns about increased intracranial pressure secondary to intracranial infections or intracranial lesions including hemorrhage or space-occupying masses. A large fontanelle along with widely separated cranial sutures suggests hydrocephalus. Prematurely fused cranial sutures, on the other hand, may be indicative of craniosynostosis.

Examination of the eyes should start with an external examination of the eyelids, conjunctiva, sclera, cornea, and iris. The presence of persistent discharge or tearing is associated with lacrimal duct obstruction, infection, allergy, or glaucoma [70]. Corneal enlargement is the hallmark of pediatric glaucoma, but the edema may be subtle especially if both eyes are involved. It is often preceded by the triad of epiphora, blepharospasm, and photophobia. In the presence of consistent signs and symptoms, an intraocular pressure of greater than 20 mm Hg in a resting infant or an asymmetry of more than 5 mm Hg are suggestive of glaucoma [71]. Suspicion for glaucoma should prompt urgent referral to a pediatric ophthalmologist. Direct ophthalmoscopy may be performed to look for the red reflex both individually and simultaneously. The red reflex should be bright reddish-yellow or light gray in the brown-eyed patients and should be symmetrical in both eyes [72].
A blunted or asymmetric reflex suggests intraocular tumors, vitreous opacities, or retinal detachment. The presence of retinal hemorrhages in the absence of a history of robust mechanism is concerning for shaken baby syndrome [73]. A thorough eye examination with fluorescein stain of the cornea should be performed in every infant with unexplained crying. Corneal abrasions have been reported in infants in the absence of trauma history and corneal redness or edema [68,74]. Similarly the lids may be retracted to look for a foreign body.

External examination of the ears is important. Look for signs of external irritation or injury. Contusions on the ear are highly suggestive of nonaccidental trauma. Otoscopy should be performed on every child to look for otitis media. In Poole’s [68] study, otitis media was the most commonly diagnosed condition among infants with unexplained excessive crying.

A history of unilateral nasal discharge is suggestive of a nasal foreign body. Because the history can often be unrevealing, nares should be examined in every infant, ambulatory and nonambulatory alike. Examination of the oropharynx may reveal thrush, pharyngitis, or vesicular lesions indicative of stomatitis. Palatal or uvular burns from ingesting hot food or liquid can also become apparent. These conditions may be accompanied by a history of decreased feeding and/or fever.

**Cardiovascular**

A history of congenital heart disease (CHD) in a child may change one’s approach to the work-up, and should be sought out. Many children with CHD are at increased risk for infective endocarditis. Infants can present with nonspecific symptoms such as fever, malaise, and irritability. They may have a new or changing murmur, splenomegaly, or petechiae on exam. Patients with known CHD and those with undiagnosed CHD can present with symptoms of congestive heart failure. In the most severe case, they can have cyanosis or shock; however, many will have less obvious complaints and signs including fussiness, agitation, and feeding difficulty. A cardiac murmur, tachypnea, diaphoresis, and hepatomegaly may be found on physical examination [75]. Infants with an anomalous left coronary artery can present with myocardial infarction and such nonspecific signs as crying and fussiness.

Patients with supraventricular tachycardia may also present with the chief complaint of fussiness. The diagnosis usually starts in triage, with the nurse reporting that the heart rate is “too fast to count.” In general, infants will present with heart rate of greater than 220 beats per minute.

**Pulmonary**

Any history of previous or chronic pulmonary disease such as recent pneumonia, bronchopulmonary dysplasia, reactive airway disease, or cystic fibrosis may be relevant. Procure a history of respiratory symptoms including
Box 1. Differential diagnosis for excessive crying in infants

*Head, eyes, ears, nose, throat*
- Trauma
- Corneal abrasion
- Ocular/nasal/ear foreign body
- Glaucoma
- Otitis media
- Oral thrush/stomatitis/pharyngitis
- Palatal burns
- Panniculitis

*Cardiovascular*
- Congestive heart failure
- Supraventricular tachycardia
- Endocarditis/myocarditis
- Myocardial infarction

*Pulmonary*
- Upper respiratory infection
- Foreign body aspiration
- Pneumothorax
- Pneumonia

*Gastrointestinal*
- Constipation
- Anal fissure
- Hemorrhoids
- Bowel obstruction
- Intussusception
- Malrotation/midgut volvulus
- Hirschsprung’s disease
- Milk protein allergy
- GERD/Esophagitis
- Celiac disease
- Appendicitis
- Peritonitis

*Genitourinary*
- Testicular torsion
- Incarcerated inguinal hernia
- Genital tourniquets
- Balanitis/posthitis/balanoposthitis
- Hydrocele
- Urinary retention
- Urinary tract infection
cough, wheezing, dyspnea, or tachypnea. This is not always offered without prompting when the main complaint is crying especially if the event was transient and thus deemed insignificant. The possibility of a foreign body in the airway is present even in the nonambulatory infant especially if they have been around other young children. If the index of suspicion is high, bilateral

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decubitus chest radiographs may be indicated. Inadequate oxygenation or ventilation resulting in air hunger can manifest outwardly with nonspecific symptoms such as irritability. Note the general work of breathing. Auscultation of the lungs yielding abnormal sounds should prompt a chest radiograph.

**Gastrointestinal**

A history of vomiting or diarrhea or an abdominal examination revealing tenderness, distention, or a mass could direct the work-up and diagnosis in a child with excessive crying. The rectum should be examined in every case for anal fissures or hemorrhoids. Bright red blood may be seen in the stools but not invariably. Constipation is a common problem that can cause discomfort and irritability and, oftentimes, the diagnosis is made based solely on a history of stooling patterns [68]. Bilious vomiting points to a process occurring distal to the ampulla of vater, whereas nonbilious vomiting suggests that there is a problem proximal to the ampulla. Gastrointestinal symptoms are, however, often more subtle especially in young infants.

Intussusception is a serious condition that has a peak incidence between 3 and 9 months of age. One retrospective chart review of 90 patients diagnosed with intussusception found that 92% of patients were under the age of 1 year [76]. Only 30% of patients had bloody stools, while the combination of vomiting, blood per rectum, and abdominal mass was found in 29%. The triad of vomiting, screaming attacks, and lethargy was found in 38%. Vomiting alone or in combination with other signs or symptoms was the most common clinical manifestation of intussusception, but screaming attacks ranked second with 74% of infants presenting with it. The incidence of intussusception appears to be concentrated during the warmer months. It occurs not uncommonly in conjunction with common viral illnesses including upper respiratory infections. The newly released rotavirus vaccine is currently suspected of causing intussusception in vaccine recipients. Suspicion should also be high when there is unexplained crying with vomiting and/or lethargy. Plain radiographs are diagnostic in less than half of cases. Barium enema can be both diagnostic and therapeutic and has traditionally been the study of choice. More recently, air and saline hydrostatic reductions have also been performed. The use of ultrasound as a diagnostic modality has achieved good results at centers with experienced radiologists [77].

Other causes of bowel obstruction that can present early with nonspecific signs and symptoms include midgut volvulus, and Hirschsprung’s disease. Although Hirschsprung’s disease presents most commonly in the newborn period with bowel obstruction and bilious emesis, children can present later with irritability and a history of chronic severe constipation. Classically there is a failure to pass stools within the first 24 hours of life. The rectal examination may reveal an empty rectal vault [77]. Midgut volvulus occurs in those that have intestinal malrotation during fetal development. They may present from the newborn period into adulthood, but most become
symptomatic during the first year of life with a concentration during the first month of life. Early signs include acute onset of abdominal pain and bilious emesis. Abdominal distension and tenderness, hematemesis, and passage of blood from the rectum develop later [77,78]. Again, a high index of suspicion is required for early diagnosis and management. Chronic intermittent midgut volvulus may have a more subtle presentation including recurrent bouts of abdominal pain and malabsorption, constipation alternating with diarrhea, and intolerance to solid food. The upper GI series is the diagnostic modality of choice in the stable patient [77].

Genitourinary

A careful physical examination of the genitourinary area may suggest testicular torsion or incarcerated inguinal hernias, both surgical emergencies. The incidence of congenital inguinal hernia has been reported to be between 0.8% and 4.0% of live births, and during the first 6 months of life the risk of the hernia becoming incarcerated may be as high as 60.0% [79]. An incarcerated inguinal hernia presents as scrotal swelling that can extend to the inguinal area that may or may not be tender [80]. The incidence of testicular torsion peaks during the perinatal period and the peripubertal period. Patients may present with acute onset of scrotal pain, tenderness, and swelling often accompanied by nausea and vomiting. A Doppler ultrasound is needed to diagnose and differentiate it from other causes of scrotal swelling including orchitis, epididymitis, trauma, and hydrocele. Hydroceles are a common cause of scrotal swelling in infants and, although usually painless, can cause diffuse discomfort. Transillumination can help confirm the presence of a hydrocele, but an ultrasound may be needed for evaluation of possible associated pathology [79,81].

Other causes of discomfort that may be uncovered with physical examination include genital tourniquets, balanitis, posthitis, and balanoposthitis. Genital tourniquets are surgical emergencies that can lead to ischemic injury to the organ if not promptly relieved. Balanitis, posthitis, and balanoposthitis are commonly the result of inadequate hygiene or external irritation [79]. A history of recent urethral catheterization or instrumentation may be significant. Obtaining a urinalysis to screen for urinary tract infections in infants with a normal exam and continued unexplained crying can be helpful [68].

Musculoskeletal

A history of trauma is important. It is vital to obtain a clear and detailed history including time of injury occurrence and mechanism of injury. Fractures are the second most common presentation of abuse, and up to 80% of fractures occurring in infants less than a year of age have been attributed to abuse [82]. Carefully palpate the body and extremities for swelling or tenderness. Oftentimes, the chief complaint is vague consisting only of a fussy or
irritable infant, swollen extremity, or refusal to move a limb. In one study with 215 children 3 years of age and younger with sustained fractures, 52 (24%) were determined to be the result of abuse. Abuse was found to be more likely if there was no history of trauma, the extent of injury was greater than expected, there was an extremity fracture in a child less than 1 year of age, or there was a midshaft or metaphyseal humerus fracture [83]. Fractures with high specificity for abuse include classic metaphyseal lesions, posterior rib fractures, scapula fractures, spinous process fractures, and sternal fractures [84].

Examine all bones and joints for warmth, swelling, tenderness, or irritability that may suggest osteomyelitis, or arthritis. Osteomyelitis in infants and especially neonates can have delayed diagnoses because signs and symptoms are often nonspecific. These include irritability, decreased use of the affected limb, and fever. There may be redness or swelling of the soft tissue over the affected area. Neonates with osteomyelitis may show solely pseudoparalysis and tenderness over the site. Septic arthritis can present similarly with acute onset of irritability, fever, limp in the ambulatory child, or joint irritability, redness, and swelling [85,86]. The child may hold the joint in such a position that maximizes intracapsular volume and comfort. Hips may be flexed, abducted, and externally rotated, and knees may be moderately flexed [86]. The differential diagnosis includes inflammatory or reactive arthritis and malignancy. Dactylitis, microinfarcts in the phalanges and metatarsal bones, occurs in individuals with sickle-cell disease, most commonly in infancy, and can mimic osteomyelitis [85,87]. Children with acutely swollen digits should be examined carefully for digital tourniquets.

**Neurologic**

Many neurological disorders can present with nonspecific signs and symptoms especially in young infants. Birth history should include a history of maternal drug use since neonates in drug withdrawal are often irritable, jittery, and difficult to console. A careful neurological exam should be performed on all patients. Focal neurological findings might raise concern for increased intracranial pressure. Infants with acute intracranial hemorrhage, cerebral edema, or hydrocephalus can initially present with fussiness, irritability, decreased activity or feeding, or lethargy. Those with chronic subdural hematomas, hydrocephalus, intracranial mass, or chiari malformation type I may also have poor weight gain or failure to thrive and developmental delay [88].

An external examination of the head and scalp is important as stated above. However, infants with inflicted traumatic brain injuries commonly present without external signs of trauma and a wide spectrum of signs and symptoms. Many have normal neurological examinations [89–91]. Rubin and colleagues [91] reviewed the records of children younger than 2 years with injuries suspicious for child abuse, a normal neurological exam, normal scalp exam, and at least one high-risk criteria, namely rib fractures, multiple
fractures, facial injuries, or an age of less than 6 months. They found that 19 (37%) of 51 had occult head injuries found on computed tomography. Consider imaging the head when there is suspicion for abuse in the young infant.

Meningitis or encephalitis should always be a consideration in the irritable infant. During the early course of systemic infections, young infants may present with crying, irritability, or fussiness without fever [92]. Patients who are ill-appearing, or have unabated crying during the emergency department visit should be observed either in the department or in the hospital and may require further ancillary testing. In Poole’s [68] small study, serious illness was found to be unlikely in the face of a normal physical exam and an infant who did not continue to cry beyond the initial assessment.

**Dermatologic**

The skin should be examined thoroughly for infectious lesions, rashes, abrasions, and bruises. Infants with infectious skin lesions such as cellulitis or mastitis do not necessarily have fever or obvious initial findings [93]. The skin exam may also reveal papular urticaria from insect bites or spider bites. Check the child’s interdigital web spaces for lesions that could suggest infestation with *Sarcoptes scabiei*, or scabies.

Diaper dermatitis is a common condition in young infants particularly in those with a recent history of diarrhea. The resulting skin irritation can cause aggravation and restlessness. The papulosquamous lesions of atopic dermatitis may be found on the scalp, face, or extensor surfaces on infants usually sparing the diaper area. It is characterized by intense pruritis and scratching that can lead to excoriations and vesiculations [94].

Bruises are extremely rare in preambulatory infants less than 6 months of age and uncommon in those less than 9 months of age [95–97]. Therefore, when they do occur, they raise suspicion for inflicted injuries. Bruises over the ears and genitourinary and buttocks regions are rarely the results of accidental injury. Accidental bruises from falling characteristically occur over bony prominences at the front of the body [96,97]. Any injury that does not fit with the stated mechanism is a cause for concerns about possible abuse. The developmental capabilities of the infant should be taken into account when determining the plausibility of the mechanism. The same is true of burn injuries [98]. Patterned burns from the imprint of hot objects such as a cigarette or hand iron, or immersion of a body area into hot liquid are suggestive of inflicted injuries. Burns to the bilateral lower extremities and buttocks or perineal regions are seen more frequently in inflicted than accidental injuries [99].

**Metabolic/toxigenic**

The child with an inborn error of metabolism can present in the newborn period or later in life. The intricacies of various biochemical pathway defects that result in the many possible diseases are discussed in detail elsewhere [100–102]. Many of these disorders have in common enzymatic or protein
defects that lead to accumulation of toxic intermediates and neurological dysfunction. This can manifest in the early stages as irritability or lethargy and vomiting, and in later stages with a sepsis-like picture. When the toxic intermediates are acids, as is often the case, metabolic acidosis is present inducing tachypnea. Older infants and toddlers typically present during periods of common viral illnesses. There may be a history of poor weight gain, developmental delay, or recurrent severe illness.

Hypoglycemia is important particularly in the neonatal period. It is relatively common in newborns especially in those who are premature or small for gestational age. In most cases, it is a transient process, a consequence of poor glucose and fat stores and immature glucoregulatory mechanisms that resolves over a matter of days. Newborn infants of diabetic mothers can also have hypoglycemia from transient hyperinsulinemia that usually resolves over 3 to 5 days. Hypoglycemia occurring past the newborn period could suggest pituitary or adrenal dysfunction; inborn errors of glucose synthesis, storage, or breakdown or fatty acid oxidation; or congenital hyperinsulinemia [101–103]. Alternatively, infants may be hypoglycemic simply from inadequate nutritional intake. It can also be one of the many manifestations of serious systemic illness including infection [104]. Hypoglycemia in infants presents with any combination of jitteriness, irritability, abnormal cry, poor feeding, respiratory distress, apnea, cyanosis, temperature instability, myoclonic jerks, and seizures.

Consider the possibility of toxic ingestions especially in ambulatory infants. In the same vein, maternal medications can be significant in breastfeeding infants who may be exposed to medications that are excreted in the breast milk. Environmental exposures can also be a consideration. Carbon monoxide poisoning is the most frequent cause of asphyxiating poisoning in the United States, and occurs more commonly in the winter months [105]. Relevant historical factors include indoor heaters and gas stove use, and household members with similar symptoms. It presents in the acute stages in adults and older children with headache, dizziness, blurred vision, confusion, nausea/vomiting, chest pain, weakness, tachycardia, and/or tachypnea. Young infants can present with irritability or lethargy and vomiting [106,107]. The classic findings of cherry-red lips, cyanosis, and retinal hemorrhages are rare. More severe poisoning can lead to apnea, seizures, dysrhythmias, or cardiopulmonary arrest. Pulse oximetry is often falsely elevated, and diagnosis requires the measurement of carboxyhemoglobin in the blood. The mainstay of treatment is supplemental oxygen [107].

Summary

The crying infant is a common clinical dilemma faced by emergency physicians. Careful consideration should be given to every case. The differential diagnosis must be tailored to the history and clinical presentation. Ordering
arbitrary tests will likely have low diagnostic yield possibly exposing the child to unneeded pain and radiation and adds to the cost burden of the medical system. Colic is a common condition in young infants. The individual history of crying pattern is necessary in making the diagnosis. The first episode of severe crying should not be easily dismissed as colic. Taking the general appearance of the child into account will guide clinical decision making. Any child who is ill-appearing or displays evidence of poor growth or development deserves further investigation. Any child who has cries inconsolably beyond the time of the initial assessment also requires further consideration. Do not forget the possibility of abuse. Screening and diagnostic testing should ideally be guided by the history and physical examination. The differential diagnosis for pathological causes of crying is considerable. To assist clinicians in recalling some of the more common causes of excessive crying, one of the authors has previously proposed the mnemonic IT CRIES (Box 2) [108].

When the diagnosis of colic is made, it is important to offer support and reassurance and suggest different methods of treatment since not all infants will respond to the same treatments. In addition, reviewing signs of ill appearance will empower the guardians and ensure prompt follow-up should the clinical picture change. A thorough systemic evaluation of the infant with the chief complaint of crying is an important skill for any clinician who works with pediatric patients. When the problem is approached in an open-minded inquisitive manner, the experience can be more satisfying for both the family and the practitioner.

References