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Characteristics of Pain and Stooling in Children with Recurrent Abdominal Pain

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Abstract

Objective—To collect symptom data longitudinally from children with recurrent abdominal pain (RAP) and Control (asymptomatic) children.

Methods—Children with RAP (n = 77) and Controls (n = 33) ages 7–10 yrs. completed daily diaries for two weeks tracking pain frequency and severity, how often the pain interfered with activities, and stooling pattern.

Results—RAP children reported a greater number of pain episodes and greater pain severity than Control children. Pain commonly was reported to be in the periumbilical area and occurred evenly across the day in both groups. However, the pain interfered with activity more often in the RAP group. There was a positive relation between pain and interference with activities. Both groups reported stool changes but there were no differences between groups in stool character (e.g., hard, mushy, etc.). For both groups the presence of watery stool was related positively to pain. Of children with RAP, 65% could be categorized as having irritable bowel syndrome (IBS) whereas 35% were classifiable as having functional abdominal pain (FAP) according to the pediatric Rome II criteria.

Conclusions—To our knowledge this is the first longitudinal report of symptoms in children with RAP compared with Controls. These data demonstrate that there is considerable overlap between children with RAP and Control children on a number of items commonly obtained in the history (e.g., pain location, timing, and stooling pattern). A majority of children with RAP could be characterized as having IBS. The relationship between pain reports and interference with activities substantiates the need to deal specifically with the abdominal pain to decrease disability. The relationship between pain and watery stools requires further study.

Keywords

Recurrent abdominal pain; diary; pain; stool pattern; irritable bowel syndrome; functional abdominal pain

INTRODUCTION

Abdominal pain is a common complaint in childhood^{1–4}. The term recurrent abdominal pain (RAP) has been used when the pain episodes repeat over time. In the 1970's, Apley defined RAP as intermittent abdominal pain in children between the ages of 4 and 16 years that persists more than three months and affects normal activity⁴. Surveys suggest that 10%–17% of children in this age group meet the criteria for RAP and that RAP accounts for at least 5% of all pediatric office visits^{3, 5, 6}. The definition of RAP was revised by Von Beyer and Walker to define better the relationship of the pain with time⁷. A pediatric working group defined the "Rome Criteria II" for functional bowel diseases in children⁸. They subdivided abdominal pain into symptom-based groupings that included functional abdominal pain (FAP) and irritable bowel syndrome (IBS) and dispensed with the term RAP. The definition of functional abdominal pain is, however, quite similar to that of RAP⁸. IBS can be thought of as FAP that is associated with changes in stool frequency, appearance, and/or abdominal pain relieved with stooling⁸. RAP can be thought of as a symptom complex whereas FAP and IBS are diagnoses⁸.

To our knowledge there have been no longitudinal studies describing the frequency and severity with which children with RAP have pain or how often the pain interferes with activity. Similarly, we know little about the stooling pattern of children with RAP or how the pattern compares with children without abdominal pain. Additionally, there are few data that describe what proportion of children presenting with the symptoms of RAP meet the definition of FAP or IBS. Further, the few data that are available were obtained only from children referred to tertiary care.

The objectives of the present study were to collect longitudinal data from children with RAP in regard to pain frequency and severity, how often the pain interferes with activities, and stooling pattern (i.e., what proportion of patients have FAP vs IBS). As a point of reference we compared these data to Control children (i.e., those without a complaint of abdominal pain).

MATERIALS AND METHODS

Participants

Participants were 7–10 years of age and recruited from a large pediatric health care network which includes primary (pediatric) and tertiary (i.e., pediatric gastroenterologist) care serving the Houston metropolitan area and which accepts both public and private insurance. Participants also were recruited from two private pediatric gastroenterology practices so that the vast majority of gastroenterology referrals in the city were identifiable.

Children with RAP were identified using the criteria of Apley as modified by von Baeyer and Walker^{4, 7, 8}. These were: 1) the pain occurs at least once each month, in at least 3 consecutive months, and within the last year, and 2) episodes have been severe enough to cause the child to stay at home, or terminate or avoid play, or take medication for pain, or rate the pain as moderate or severe ($\geq 3/10$ on a scale of pain intensity)^{4, 7}. This definition is consistent with the term functional abdominal pain proposed by the 2nd Pediatric Rome Working Group on Functional GI Diseases⁸. Children were excluded if they had organic GI illness or other significant chronic health condition requiring daily medication (e.g. diabetes) and/or specialty care follow-up (e.g., congenital heart disease). Mild chronic illnesses such as asthma were not excluded. Other exclusion criteria included an abnormal physical examination, decreased growth velocity, GI blood loss, unexplained fever, vomiting, chronic severe diarrhea, weight loss greater than or equal to 5% of their body weight within a three month period, current use of antiinflammatory (e.g., ibuprofen) or GI medications (e.g., proton pump inhibitors, antacids,

H₂ receptor blockers, laxatives, or motility agents), and previous use of GI medications that provided some symptomatic relief (this latter criteria was used to exclude children with partially treated conditions such as gastroesophageal reflux disease or constipation).

The exact temporal relationships between pain and stool changes that constitute the definition of IBS remain to be defined. El-Matary et al. have used the definition of onset of pain associated with change in stool frequency (more than 3 movements/day or fewer than 3 movements/week)⁹. We used the definition of El-Matary et al. but also used a definition which we thought better fit the Pediatric Rome II criteria for IBS: a pain episode with a change in stool character that day or the day after^{8, 9}. Children without any chronic pain complaints (including RAP) were designated as Controls.

Procedure

All recruitment and study procedures were approved by the Baylor College of Medicine Institutional Review Board and informed consent was obtained. Children 7 -10 years of age with abdominal pain initially were identified via billing codes for abdominal pain or irritable bowel syndrome at primary care pediatrician and pediatric gastroenterology offices. Medical charts then were screened for inclusion and exclusion criteria. Control subjects were recruited from the same primary care pediatrician offices by reviewing billing codes for well child visits. Control subject's charts were reviewed to insure that the children had no pain complaints of any kind in the past 3 months. Further, it was required that they had no chronic or recurrent episodes of abdominal pain.

Parents were screened further by phone. In the case of the RAP children this was to establish frequency, duration, and intensity of the child's pain complaints and ensure that symptoms were current and of sufficient severity for enrollment. For the Control children this was to insure that they had no GI complaints or other excluding characteristics. If the child met eligibility, a home visit was scheduled where the parent and child were trained on how to fill out the diary.

Measures

At the home visit the research coordinators provided the child and parent with standardized training as well as written instructions in the use of the diaries. The research coordinators maintained weekly contact with the subject and parents to help insure that the diaries were completed. A coupon for a video rental was provided if at least 90% of the diary was completed.

Pain and Interference Diary—Ratings were made 3 times a day (awakening, after lunch, and evening) over the two week period. The child rated the pain using a visual analogue scale (VAS) where they drew a line across a 10 cm horizontal line anchored with the phrases “no pain at all” and “worst pain you can imagine.” The pain intensity score was established by measuring the distance from the left end of the line in millimeters. The VAS has been used widely and found to be valid and reliable in measuring children's pain including RAP pain^{10–12}. The VAS is easy to administer and has not been found to have the problems with unequal intervals and response biases reported for the popular faces pain scales^{13, 14}.

At each time point, the child also rated interference with activity. This was rated on a 4-point scale (no interference, a little interference, much interference, unable to participate in activity)^{15, 16}.

At the home visit the child was helped to use the diary to rate standard painful situations involving the leg (e.g., basketball bounces into knee, falls and scrapes knee, breaks leg) and helped to make pain and interference ratings based on those events. This was done to ascertain

that the child understood the diary rating system and could fill out the diary without parental help. However, it was acceptable and encouraged that parents reminded the child to complete the diary. To avoid taking the diary to school and to make the after lunch rating the child was encouraged to remember that rating and mark it in the diary immediately after school.

Stooling Pattern—Stooling pattern was tracked daily over the two week period. They identified whether the stool was watery, mushy, formed, hard balls, or if there was no stool passed based on pictures provided in the diary. The diary had been validated previously¹⁷. The research coordinators also instructed the child and parent on the use of this diary and provided written instructions. Parents were asked to assist the child with the stooling diary (ensure that the record was kept and assist with comparison to the pictures on the stooling diary).

Data Analyses

Statistical analyses were conducted using SAS version 9.0 (SAS Institute Inc., Cary, NC). We used t-tests to compare results between groups. Three measures of pain were compared across groups. First, each child's mean level of severity of pain episodes across the 42 time points (3 times a day for 14 days) was computed. The second outcome was the maximum level of pain recorded in the two week period. Third, the number of pain episodes reported was used as an outcome. A pain episode was defined as a mark greater than 20 mm on the VAS. T-tests were computed to compare mean level of pain severity, maximum pain level, and the frequency of pain episodes between children with RAP and controls. The folded-f test was used to determine if the two samples had equal variances. If the variances were unequal the Satterthwaite test correction was used.

Multilevel random effect models were used to investigate the relation between pain, stooling pattern, and group membership. This analytic method takes into account the nesting of data within person over time. PROC MIXED in SAS was used to construct linear multilevel random effect analyses that took into account time within children and controlled for autocorrelation or dependency between time points and pain. Multilevel models offer a number of advantages including: 1) the ability to examine within person factors such as stool pattern on changes in pain and disability and 2) methods for handling missing data which is common in daily diary studies. Data are expressed as mean $\pm$ SD.

RESULTS

Demographics

118 participants were recruited. Two of the 118 cases did not return the diary at all and an additional 6 participants did not record any pain ratings on their diary resulting in a final sample of 110 children. A complete description of the sample is included in Table 1. Of the 77 children in the RAP group, 40 were recruited through their primary care physician (pediatrician) and 37 were recruited through their pediatric gastroenterologist of whom 17 were recruited through the academic GI service and 20 through the private practice GI service.

The mean age of the children was 8.6 ± 1.1 years with 70 % girls. The age and racial distributions did not differ between the groups. There were no significant differences between groups in socioeconomic status as measured by the mother's level of education.

First, we examined pain frequency, pain interference with activity, and stooling pattern from the daily diary by calculating descriptive characteristics across the 14 day period. Second, we examined the possible relationships between the presence of RAP on pain and stool patterns. Third, we analyzed daily associations between pain, interference with activities, and stool

pattern using multilevel random effects models to examine the same day within subject relationships between pain frequency, pain interference with activity, and stool pattern.

Pain

Despite having been screened at the time of recruitment Control children did report episodes of abdominal pain. However, there were significantly more pain episodes in the RAP group compared with Controls (Table 2; $t(1, 108) = -4.2$, $P < 0.01$). Additionally, the RAP group reported a significantly greater number of pain episodes at lunch compared to Controls (Table 2; Chi Square = 23.1 (df = 12), $P < 0.05$). For all groups the location of the pain was most commonly in the periumbilical area. RAP and Control children often noted pain in more than one location (Table 2). There was no correlation between pain timing, severity, and location.

The RAP group reported significantly higher mean levels of pain severity overall (Table 2; $t(1, 108) = -3.5$, $P < 0.01$). Also the RAP group reported a significantly higher maximum level of pain compared to Controls (Table 2; $t(1, 108) = -3.42$, $P < 0.01$). Multilevel random effects models indicated that on a day-to-day basis, children who were diagnosed with RAP reported significantly higher levels of pain compared to Control children (Table 4; $B = 4.75$, $t = 4.97$, $P < 0.001$).

Pain Interference with Activity

A Chi square test was conducted to evaluate if there were differences between groups on how much the pain interfered with activities. Table 2 shows the percentage of time that pain interfered with activities rated on a 4-point scale. Chi square tests demonstrated that the pain interfered with activities significantly more often and at a higher level of intensity in the RAP group compared to Control group ($P < 0.001$).

Multilevel random effect models indicated that there was a positive relation between pain and interference such that an increase in pain was related to increased interference with activity (Table 4; $B = 0.021$, $t = 29.54$, $P < 0.001$). In addition, there was a significant interaction between group and pain indicating that the RAP group was more likely to report higher levels of interference across all levels of pain (Table 4; $B = 0.038$, $t = 4.74$, $P < 0.01$).

Stooling

There were no differences between groups in the number of stools passed per child over the two week period (Table 3; $T(1,108) = -0.07$, NS). There was no difference between groups on the type of stools such as mushy, hard balls, watery, or the number of days without a bowel movement (Table 3). Using the definition of El-Matary et al. (more than 3 movements/day or fewer than 3 movements/week) 32/77 RAP children had IBS and 27/77 had FAP⁹. Using our own criteria of having a pain episode with a change in stool character that day or the day after 50/77 children had IBS and 27/77 had FAP.

Multilevel random effect models were conducted to examine the relation between stool pattern and pain on a day to day basis (Table 4). These models indicated that there was a significant relation between stool types in predicting pain indicating only mushy stool was significantly associated with increased pain ($B = 5.5$, $t = 3.12$, $P < 0.01$). Further examination of the relation between stool type and pain revealed that there was a significant interaction between group and mushy stool in its relation to pain ($B = 3.65$, $t = 2.67$, $P < 0.01$). This interaction is such that the RAP group reported significantly higher levels of pain when their stool was mushy compared to the Control group.

DISCUSSION

To our knowledge, our study is the first to compare longitudinally the pain symptoms and bowel habits of children with RAP, and further, to compare these to normal children. Unlike previous studies of RAP ours was not just focused on children referred to tertiary care. We also were able to examine the potential relationship between episodes of pain and interference with the child's activities.

Control children without a history of abdominal pain on the three screening steps did record episodes on pain in their two-week diary. However, the RAP group experienced more pain episodes whose mean severity and maximum intensity were greater compared with Controls (Table 2).

Although it has been suggested that the pain in RAP occurs more commonly in the morning perhaps as part of an aversion to going to school our data suggest that the pain is experienced evenly throughout the day from morning to evening (Table 2)^{8, 18}. Previous studies have noted that the pain in RAP is periumbilical^{4, 19}. Although our data support this contention, it is important that in more than half of the cases the pain was located in other areas of the abdomen and/or in more than one location (Table 2). In addition, there was no relation between the pain location or severity of pain and the time of day the pain occurred.

Abdominal pain interferes with activities more commonly in children with RAP compared with Controls (Table 2). However, there was no difference between the groups in the level of interference. Even 15% of Control children had abdominal pain severe enough at some time that it caused interference or prevented participation in activities (Table 2). To our knowledge these findings have not been reported previously. However, they fit with the observation of Malaty et al. that pain disability is an important dimension in the development of a multidimensional measure for RAP²⁰.

The results of the stool diaries from the Controls point out that normal children experience day to day variation in stooling pattern (Table 3). Day to day variation in stool frequency and consistency may depend on the child's diet^{21–23}. For the most part children with RAP and Controls described their stools similarly (Table 3). Approximately 15% of each group had stools that were watery or mushy. Both groups had a similar number of stools passed per day and the number of days with no stools passed also was similar between the groups (Table 3). There was no relationship between the occurrence of pain and the passage of hard stool. On the contrary, there was a significant relationship between the severity of pain and mushy stools. This could not be attributed to an intercurrent illness as none of the parents reported their children as being ill during the two week period. Studies in adults demonstrate that individuals with IBS commonly move from one functional category to another (e.g., IBS with diarrhea to FAP to IBS with constipation) although over time the IBS diagnosis is durable²⁴. Our data suggest that children may follow a similar course.

Presumably stools that were reported as watery, mushy, or hard intimate that the child could meet the criteria for IBS⁸. Walker et al. had parents and children 4 – 17 years of age with RAP (n = 107) awaiting a visit to a pediatric gastroenterologist complete a symptom questionnaire²⁵. Based on the responses 45% and 7.5% of the children met the Pediatric Rome II criteria for IBS and FAP, respectively²⁵. However, in the definition of IBS used by this group in their retrospective study there is no reference to timing other than to say that the pain was associated with a change in stool character²⁵.

El-Matary studied 103 children (10 ± 3.4 years of age, mean ± SD) referred to a pediatric gastroenterologist who fulfilled Apley's criteria for abdominal pain^{4, 9}. Of the children with non-organic pain, 36% met the Pediatric Rome II criteria for IBS whereas 30% had FAP⁹.

²⁵. Using the El-Matary definition (more than 3 movements/day or fewer than 3 movements/week) we found that 42% of the children in our sample had symptoms compatible with IBS whereas 35% had FAP ⁹. Differences between the results of our study and those of Walker et al. and El-Matary et al. may be explained by differences in the ages of the children, that categorization in our study was based on the two week diary versus a single episode of recall, and that their studies only examined children referred to tertiary care ^{9, 25}. Using our own definition of IBS (pain episode with a change in stool character that day or the day after) 65% of children in our sample had IBS and 35% had FAP.

Some qualification should be borne in mind in extrapolating our results. We studied children between 7 – 10 years of age. Whether the results apply to younger or older children needs to be established. Although detailed instructions were given to the parents and children and constant contact was maintained throughout the study period, it is possible that not all the data was filled in each day but recorded in two (or more) day blocks. However, despite this potential limitation the results should be more reliable than those based solely on long term recall.

In summary, our data point to the fact that normal children experience abdominal pain that sometimes interferes with activity and that their bowel pattern often varies. These data demonstrate the overlap in symptoms such as pain (severity, timing, location) and stool changes between children with and without RAP. The difference between RAP and Control children appears to be in the degree of symptoms rather than the symptoms themselves. Indirectly, these results support the importance of inquiring regarding the presence of other symptoms (“alarm symptoms” - e.g., weight loss, extraintestinal manifestations, fever, etc.) in identifying children with organic disease as opposed to RAP ^{26, 27}. The relationship between the experience of pain and the presence of mushy stools is intriguing and requires further study.

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Table 1

Description of Study Sample

	RAP n = 77	Control n = 33
Female (%)	58 (75.3)	19 (57.6)
Age	8.7 ± 1.0*	8.6 ± 1.1
Race/Ethnicity (%)		
White, non-Hispanic	53 (68.8)	25 (75.8)
Black, non-Hispanic	9 (11.7)	2 (6.1)
Hispanic	14 (18.2)	6 (18.2)
Asian	1 (1.3)	0 (0.0)
Educational level of the mother (%)		
No High School degree	1 (1.3)	0 (0.0)
High School degree or GED	11 (14.3)	2 (6.1)
Some College	22 (28.6)	5 (15.2)
Specialized Training	11 (14.3)	4 (12.1)
College Graduate	24 (31.2)	16 (48.5)
Professional Degree	6 (7.8)	6 (18.2)
Other	2 (2.6)	0 (0.0)
Insurance Status (%)		
Medicaid/CHIPS	11 (14.3)	4 (12.1)
HMO/PPO	55 (71.4)	20 (60.6)
Other	5 (6.5)	0 (0.0)
Information not available	8 (10.4)	9 (27.3)

* Mean ± SD

Table 2

Pain Frequency and Severity and Interference with Activity over 2 weeks

	RAP n = 77	Control n = 33	P Value
Total number of reported pain episodes	525	72	< 0.05
Mean number of pain episodes over 2 weeks	7.4 ± 8.8*	2.2 ± 4.2	< 0.01
Percent of total pain episodes occurring in the:			
Morning	30% (n=160)	31% (n=22)	
Afternoon	36% (n=190)	29% (n=21)	< 0.05
Evening	33% (n=175)	40% (n=29)	
Mean severity of all pain episodes	12.5 ± 15.3	4.9 ± 6.9	< 0.01
Mean severity of maximum reported pain	53.2 ± 31.0	30.3 ± 34.8	< 0.01
Location of pain (%)			
Periumbilical	40% (n=31)	27% (n=9)	
Right upper quadrant	12% (n= 9)	9% (n= 3)	
Left upper quadrant	18% (n= 14)	21% (n= 7)	
Right lower quadrant	9% (n= 7)	9% (n= 3)	
Left lower quadrant	9% (n= 7)	15% (n= 5)	
Epigastric	14% (n=11)	18% (n= 6)	
Hypogastric	10% (n=8)	12% (n= 4)	
Percent of interference ratings:			Overall RAP vs Control
			p < 0.001
No interference	16.8%	58.2%	
A little interference	59.2%	23.9%	
Much interference	20.0%	14.2%	
Unable to participate in activity	4.0%	3.7%	

* Mean ± SD

Table 3

Stooling Pattern over 2 Weeks

	RAP n = 77	Control n = 33
Percent of stools that were	Total n = 1218	Total n = 554
Watery	4	1
Mushy	16	17
Formed	65	68
Hard balls	15	14
Percent of days with no stool passed	20	22

Table 4

Summary of Multilevel Random Effects Analyses of Associations between Pain Stool Pattern and Interference

Predictors	Outcomes			
	Pain		Interference	
	B	t	B	T
Group	4.75	4.97**	0.027	1.4
Pain			0.021	29.54***
Pain * group			.038	4.74*
Stool- Watery	7.59	0.07		
Stool- Mushy	2.96	3.30**		
Stool- Normal	1.18	1.14		
Stool- Hard	1.62	-0.02		
Stool- No Bowel Movement	1.21	2.13		
Stool - Mushy* Group	3.65	2.67**		

* P < 0.05

** P < 0.01

*** P < 0.001