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ORIGINAL RESEARCH

Stress and Well-Being Among Parents of Children with Potocki-Lupski Syndrome

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Abstract Potocki-Lupski syndrome (PTLS) or duplication 17p11.2 syndrome is a newly characterized condition causing a variety of health problems with variable severity, including failure to thrive in infancy and childhood, hypotonia, structural heart anomalies, cognitive impairments, speech and learning difficulties, and autism. Due to its recent clinical characterization little is known about the psychosocial impact of this condition on patients and their families. This study evaluated whether parental psychosocial outcomes were associated with children's PTLS disease severity. Parents of 58 children with PTLS completed a cross-sectional survey that assessed parental stress, quality of life, and coping skills. Parental functioning was associated with greater severity of feeding difficulty and with lower severity of a cardiovascular defect. Findings from this study highlight potential support needs of parents of children affected by PTLS and suggest ways in which these needs may be addressed.

Keywords Parental functioning and coping · Disease severity · Potocki-Lupski syndrome · Duplication 17p11.2

Introduction

Potocki-Lupski syndrome (PTLS: MIM 610883) is a genomic disorder associated with a chromosomal microduplication of 17p11.2 and is the first reciprocal microduplication syndrome described (Potocki et al. 2000). At the time of its description PTLS represented a paradigm shift in medical genetics, initially identified by molecular characterization with clinical features defined in subsequent studies (Potocki et al. 2000). The majority of PTLS patients harbor a de novo 3.7 Mb duplication, however duplications as small as 125 kb containing only the *RAI1* gene have been identified, as well as larger duplications which span the *PMP22* gene within 17p12 (Potocki et al. 2007;

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Zhang et al. 2010). To date there is a single report of a maternally inherited dup(17)(p11.2) (Yusupov et al. 2011). Clinical features which are most common in persons with PTLS include hypotonia, poor feeding, failure to thrive, and developmental delay during infancy; speech and language impairment, inattention, and hyperactivity in early childhood; and intellectual disability, autism spectrum disorder, and behavioral abnormalities in older children. Cardiovascular abnormalities and sleep-disordered breathing are diagnosed in just under 50 % of patients (Potocki et al. 2007; Sanchez-Valle et al. 2011; Soler-Alfonso et al. 2011; Treadwell-Deering et al. 2010; Jeffries et al. 2012). Although persons with PTLS share common facial features, most are not considered dysmorphic.

Fewer than 100 cases of PTLS have been reported, as the common PTLS microduplication is difficult to detect on routine cytogenetic analyses. However, availability of array-based comparative genomic hybridization (aCGH) in the clinical laboratory is anticipated to increase the number of diagnoses of PTLS, as its routine use is increasing as a means of detecting genomic imbalances in patients evaluated for developmental delay, autism, and dysmorphic features (Stankiewicz and Beaudet 2007).

Clinical understanding of the phenotype of PTLS will continue to improve as more individuals are identified. Existing studies on PTLS have focused exclusively on the clinical characterization and genetic mechanisms of PTLS and to our knowledge, there are no studies of the psychosocial impact of the disease on affected families. Prior studies have evaluated the psychosocial impact of rare genetic conditions on families, and have found that experiencing the diagnosis of such conditions may be associated with feelings of isolation, difficulty in obtaining a correct diagnosis, finding accurate information about the disease, and managing everyday caregiving (Dellve et al. 2006). However, the extent to which findings from other studies on rare genetic conditions generalize to PTLS is not known. Health care providers and affected families may have difficulty anticipating the level and type of care needed for individuals with PTLS, given the variable expression and relative newness of this disorder.

The aims of this study were to evaluate psychosocial functioning and coping strategies in parents of children with PTLS, and to compare the severity of clinical features of PTLS with parental well-being, stress, and coping. This study is the first to examine psychosocial outcomes in parents of children with PTLS.

Methods

Participants

This study was approved by the institutional review boards at Baylor College of Medicine and the University of Texas Health Science Center at Houston. Eligible persons included those who had children with cytogenetically confirmed PTLS who also were: 1) enrolled in a PTLS clinical and/or molecular research protocol; or, 2) seeking future enrollment in PTLS clinical and/or molecular research protocol(s); or, 3) followed longitudinally at the Texas Children's Hospital Genetics Clinic. Study invitations and questionnaires were mailed to 58 eligible parents of PTLS patients, 3 of which were returned due to incorrect address information. One questionnaire was sent to each household with study instructions requesting that it be filled out by one English-speaking parent. All data were collected anonymously; neither the names of the participants nor their children were included in the questionnaire. In addition to the measures described below, data collected included information on caregiver demographic characteristics and children's medical history.

Measures

PedsQL Family Impact Module

The PedsQL Family Impact Module (Varni et al. 2004) is a validated measure designed to assess parental health-related quality of life (HRQL) and family functioning in relation to a chronic pediatric health condition in children ages 2 to 18 years, consisting of 36 items regarding different functional dimensions. Using a five-point Likert scale from 0 to 4, participants were asked to select their level of functioning by indicating how often in the past one month (0[Never] to 4[Almost Always]) they have perceived difficulties in dimensions of Physical, Emotional, Social, and Cognitive function, Communication, and Worry as a result of their child's chronic illness. Parents were also assessed on family functioning in dimensions of Daily Activities and Family Relationships. Responses corresponded to scores (0/Never = 100, 4/Almost Always = 0), with higher scores indicative of better functioning (for example: an answer of "Never" to the question of "In the past 1 month, as a result of your child's health, how often has your family experienced conflicts between family members?" results in a score of 100 and indicates better functioning in the dimension of Family Relationships). Total Score, HRQL, and overall Family Functioning scores were calculated for each parent. The Parent HRQL Summary Score measured the impact of the child's chronic disorder on the parent's health-related quality of life. The Family Functioning Score specifically assessed the impact the child's illness had on the relationships and daily activities of the family. The PedsQL Family Impact Module has been used in other studies assessing the quality of life of parents of children with conditions including spina bifida, cerebral palsy, developmental delay, and cancer. This module has good internal consistency reliability (Crohnbach's α=0.97 for the PedsQL Family Impact Module Total Scale Score; α=0.96 for the Parent

HRQL Summary Score; α=0.90 for the Family Functioning Summary Score; and average α=0.90 for the Module Scales [Varni et al. 2004]).

Coping Health Inventory for Parents (CHIP)

The Coping Health Inventory for Parents (CHIP) is a validated instrument measuring parental response to the management of family life with a seriously and/or chronically ill child (McCubbin et al. 1983). The CHIP consists of 45 statements regarding coping techniques, assessing how helpful the participant perceives a variety of coping behaviors to be in parenting a child with a chronic health condition. Using a four-point Likert scale from 0 to 3 and two check-boxes, participants ranked the level of helpfulness of each coping behavior (Not Helpful = 0, Extremely Helpful = 3). The options of "Not Used" or "Not Possible" were also available as check-boxes, both corresponding to a score of 0. Coping behaviors were measured based on the parent's report of how helpful each method is in managing stress associated with having a child with PTLS through three subscales: 1) Maintaining family integration, cooperation, and an optimistic definition of the situation, 2) Maintaining social support, self-esteem and psychological stability, and 3) Understanding the medical situation through communication with other parents and consultation with medical staff. Higher scores indicate greater satisfaction with or helpfulness of that method of coping. The CHIP has been used in other studies assessing coping strategies in parents of children with conditions including juvenile idiopathic arthritis, insulin-dependent diabetes, epilepsy, and developmental delay. Internal consistency reliability is good (α=0.79 for Subscale 1, α=0.79 for Subscale 2, and α=0.71 for Subscale 3 [McCubbin et al. 1983]).

Disease Severity Scale

A disease severity scale (Table 1) was developed for this study based on clinical expertise of medical specialists involved in the care of children with PTLS. This scale was subdivided into five clinical feature subscales of PTLS, including motor delay, speech/communicative delay, feeding difficulties, autism, and cardiovascular defects. Parents were asked, based on their perspective, to indicate whether each feature was absent, mild, moderate, or severe in their child. Diagnostic markers were used to help guide parents in selecting the severity of each feature (ex: feeding difficulties are absent [no difficulties], mild [managed diet, e.g. change in nipple], moderate [naso-gastric/oro-gastric tube], or severe [gastric-tube]). Responses correspond to scores (Absent = 0, Severe = 3). Comparisons of parental functioning and coping were made within each clinical feature to determine the impact of the feature's perceived severity on the parent's well-being.

Statistical Analysis

Descriptive statistics, chi-square, and *t*-test analysis were utilized to make comparisons for each variable of interest including demographics, occupational history, and child's medical history. Parent and family functioning scores were calculated for each participant using the scoring instructions for the PedsQL Family Impact Module. Each functioning dimension was compared between the groups, as well as the Family Impact Module Total Scale Score, Parent HRQL Summary Score, and Family Functioning Score. Coping behavior scores were calculated using the scoring instructions of the CHIP. The scores of four groups of individuals were compared within a specific disease characteristic based on the response of the parent (absent vs. mild vs. moderate vs. severe). Based on the results of the four-grade disease scores, an analysis of variance (ANOVA, used for normally distributed continuous data) or a Kruskal-Wallis test (used for non-normally distributed or ordinal data) was performed to determine if significant differences were present between the functioning and coping of parents of children of varying disorder severity. An alpha value of 0.05 was used to test for significance for all analyses performed.

Results

Twenty-nine parents participated in this study for an overall response rate of 53 %. The disease severity scale from one of the returned questionnaires was not completed correctly and was therefore used to obtain demographic information only and excluded from analysis. The majority of the respondents were mothers (86 %) and the mean age was 38.3 years (range, 29–57 years). Participants' demographic characteristics are presented in Table 2.

As reported by the parents, the age of PTLS diagnosis in children ranged from 3 weeks to 17 years, with a mean age of diagnosis at 3.6 years. The majority of parents (87 %) reported that they received their child's diagnosis of PTLS from a geneticist. Forty-one percent of parents reported the need for occupational, speech, or physical therapy three or more times weekly, with 38 % receiving treatment at home or through the child's school. Only 24 % reported traveling fewer than 5 miles to receive treatment. Medical history characteristics of PTLS-affected children, as reported by parents, are presented in Table 3.

Parental ratings of the severity of motor delay, communication problems, feeding difficulties, autism, and cardiovascular defects (e.g., absent vs. mild vs. moderate vs. severe) were examined in relation to the CHIP and PedsQL Family Impact Module scores. The functioning scores among parents of children with motor delay, speech delay, or autism were similar across the severity ratings. However, parental ratings of feeding difficulties and

Table 1 Dimensions and scoring for disease severity scale in PTLS

Clinical Feature	Severity level	Score
Motor Delay (e.g. rolling over, crawling, walking)	Appropriate for my child's age	0
	Some delay identified in school	1
	Some delay identified between 1 and 3 years of life	2
	Some delay identified between birth and 1 year of life	3
Speech or ability to communicate (relative to age)	Babbling/mature jargoning at less than 2 years of life; phrases/sentences leading to effective communication	0
	Phrases/sentences with less than 4 words	1
	Single words only	2
	No verbal language	3
Feeding difficulties	No difficulties	0
	Managed diet therapy (change in nipple)	1
	Naso-gastric/oro-gastric (NG) tube	2
	Gastric-tube	3
Autism	My child has not been diagnosed with autism	0
	My child exhibits 1 of these 3 features: 1) impairments in social interaction; 2) impairments in communication; 3) repetitive behavior	1
	My child exhibits 2 of these 3 features: 1) impairments in social interaction; 2) impairments in communication; 3) repetitive behavior	2
	My child exhibits 3 of these 3 features: 1) impairments in social interaction; 2) impairments in communication; 3) repetitive behavior	3
Cardiovascular (heart) defects	No abnormalities	0
	Defect present but not requiring surgery	1
	Defect present requiring surgery	2
	Defect present requiring transplant	3

cardiovascular defects were significantly associated with parental functioning, as shown in Figs. 1 and 2.

There was a trend of decreasing PedsQL functioning scores (i.e. worse functioning) with increasing severity of feeding difficulties. However, there were only two cases that reported either moderate or severe feeding difficulties. Therefore, the data was collapsed to create a new dichotomous variable coding for "no feeding difficulties" versus "any feeding difficulty." Presence of feeding difficulties of any severity was associated with decreased scores in the dimensions of Daily Activities (p=0.029), Family Relationships (p=0.004) and overall Family Functioning (p=0.001), in comparison to cases with no feeding difficulties (Fig. 1).

A trend of increasing PedsQL functioning scores (i.e. better functioning) was also observed with increasing perceived severity of cardiovascular defects. However, only 4 out of the 11 parents that reported cardiovascular issues perceived them to be either moderate (n=2) or severe (n=2). Therefore, a new dichotomous variable coding for "no cardiovascular defects" versus "any cardiovascular defects" was created and used in subsequent analyses. Higher scores were observed for the dimensions of Physical Functioning, Emotional Functioning and HRQL in the presence of cardiovascular defects compared to no defects (p=0.004, p=0.004 and p=0.007, respectively) (Fig. 2).

There were no associations observed between the coping methods assessed through the CHIP and disease severity, suggesting that disease severity was not related to the helpfulness of one coping method versus another (see Table 4). Several parents included comments on the questionnaire (Table 5), either pertaining to a question included in the survey or a more general comment at the end. While we did not anticipate receiving free response questions, they are honest representations of and expansions upon the feelings of the parents, and thus are included herein.

Discussion

Practice Implications

This study was the first to evaluate the association of disease severity and health-related familial quality of life related to PTLS. Results of this study indicate that particular aspects of PTLS and the degree of severity impact parental functioning. As initially hypothesized, the level of functioning in parents decreased as the degree of severity of feeding difficulties increased in the dimensions of Daily Activities, Family Relationships, and Family Functioning. However, one individual reported having a child with severe feeding

Table 2 Participants' demographic characteristics (n=29)

Characteristic	n (%)
Relationship to Child with PTLS	
Biological Mother	25 (86)
Biological Father	4 (14)
Age	
26–35 years	13 (45)
36–45 years	13 (45)
46–55 years	2 (7)
55+ years	1 (3)
Ethnicity	
Caucasian/White	26 (90)
Hispanic	1 (3)
Native American	2 (7)
Primary Language	
English	26 (90)
Spanish	1 (3)
Other (Dutch; German)	2 (7)
Marital Status	
Married	27 (94)
Separated	1 (3)
Divorced	1 (3)
Number in Home (including parent)	
3	11 (38)
4	13 (45)
5 or more	5 (17)
Hours Spent Interacting with Child with PTLS per Day	
0 to 4 h	4 (14)
5 to 9 h	17 (59)
10 to 14 h	5 (17)
15 to 19 h	2 (7)
20+ hours	1 (3)
Highest Education Level	
High school or GED*	3 (10)
Some college	6 (21)
Associate's Degree	1 (3)
Bachelor's Degree	10 (35)
Advanced Degree	8 (28)
Unreported	1 (3)
Employed	
Yes	23 (79)
No	6 (21)
Hours Worked per Week	
Less than 10 h	5 (17)
10 to 20 h	5 (17)
20 to 40 h	12 (42)
40+ hours	5 (17)
Unreported	2 (7)
Longest Time Worked at One Job	
1 to 3 years	1 (3)
3 to 5 years	4 (14)
5 to 10 years	10 (35)
10+ years	13 (45)
Unreported	1 (3)
Annual Income	
Less than $25,000	1 (3)
$25,000–$50,999	3 (10)
$51,000–$74,999	3 (10)
$75,000–$99,999	7 (25)
$100,000+	12 (42)
Prefer not to answer	3 (10)

*GED General Educational Development certification

difficulties, and yet reported very high levels of functioning in all of the dimensions.

The impact of disorder severity on daily activities was significant and may be explained by the demands of a child's feeding difficulties, such as managed diet therapy or use of a naso-gastric tube. These caregiving tasks are time-consuming and require a daily routine that leaves little time for household tasks and family activities. These same demands could negatively impact inter-family relationships by creating division in role responsibilities among the parents and well-siblings for children requiring more time for

Table 3 Medical characteristics of children with PTLS (n=29) as reported by parents

Variable	n (%)
Age at diagnosis	
Birth-5 years	24 (83)
6–10 years	3 (10)
11+ years	2 (7)
Diagnostic setting	
Pediatrician	2 (7)
Geneticist	25 (87)
Hospital	1 (3)
Unreported	1 (3)
Frequency of treatment	
1–2 times per week	4 (14)
2–3 times per week	9 (31)
3+ times per week	12 (41)
Not applicable	4 (14)
One-way distance to therapy	
Less than 5 miles	7 (24)
5–10 miles	5 (18)
10–20 miles	3 (10)
20–50 miles	2 (7)
Home/School	11 (38)
Unreported	1 (3)

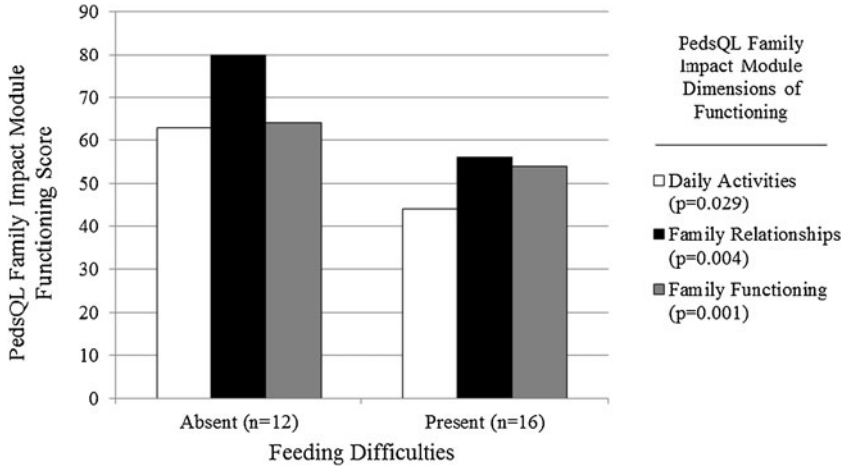

Fig. 1 Mean Parental Functioning Scores in the absence and presence of feeding difficulties. Levels of functioning in the dimensions of Daily Activities, Family Relationships, and overall Family Functioning are lower in parents of children with feeding difficulties

feeding. Although sample size limits the ability to evaluate the data, these results suggest that parents of children with increasingly severe feeding problems may benefit from recommendations from healthcare providers targeted toward techniques that may preserve time for daily activities, family relationships, and improve overall functioning.

A significant association was also identified between increasing severity of cardiovascular defects and higher HRQL scores (i.e. better quality of life) and levels of parental physical and emotional functioning. This finding was not consistent with the hypothesis. The dimension of Emotional functioning was comprised of questions asking about anxiety, sadness, anger, frustration, and helplessness. One potential explanation is that when heart defects are severe enough to require surgical repair or transplantation there may be less uncertainty involved in medical decision-making for parents, even though this level of intervention appears drastic. Despite anxiety regarding the surgery, there may be a sense of preparation which may enable better functioning. Parents of children with defects not requiring surgery may experience more fear or anxiety about the ever-present anomaly. While surgical intervention indicates a more severe problem, parents of these children may feel more pro-active or a stronger sense of control. Questions relating to Physical functioning were associated with feelings of tiredness, nausea, weakness, and frequent headaches. The presence of these feelings may be linked to the low levels of Emotional functioning, representing physical manifestations of anxiety or frustration related to the persistent concern for the heart defect or lack of feelings of control.

Higher HRQL could also suggest that health-related parental quality of life was improved knowing that the defect was surgically repairable rather than uncertainty about an unrepaired defect. Care provided by medical professionals could therefore focus on alleviating the levels of anxiety and helplessness a parent may be experiencing from a child with a heart defect not requiring surgery.

Several studies have found that greater functional severity in a child (referring to impairments in hearing, seeing, communicating, play or daily activities) is often associated with higher parental distress and poorer quality of life and adjustment in a parent (Canning et al. 1996; Rodrigues and Patterson 2007; Silver et al. 1998). The features that were assessed in this

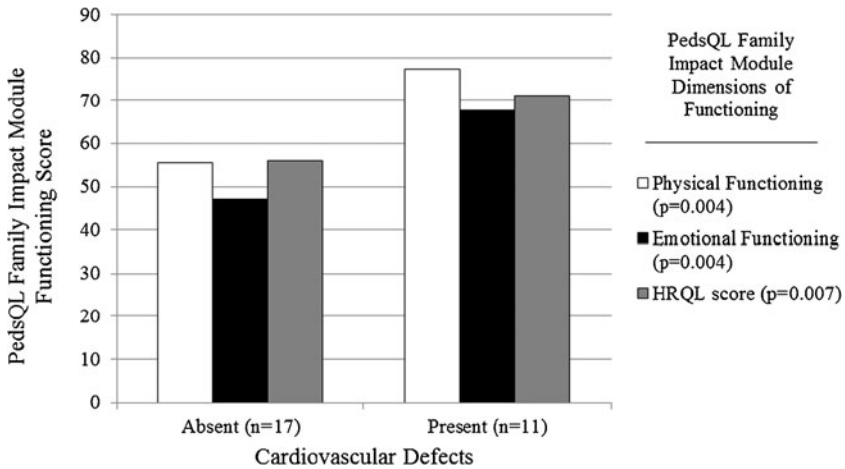

Fig. 2 Mean Parental Functioning Scores in the absence and presence of cardiovascular defects. Levels of functioning in the dimensions of Physical and Emotional Functioning and Health-Related Quality of Life (HRQL) are better in parents of children with a cardiovascular defect

Table 4 Parents' scores on the Coping Health Inventory for Parents (CHIP)

CHIP subscales	Mean (S.D.)	Range	Maximum score
Coping behavior 1: family integration and cooperation	38.34 (5.23)	31–51	57
Coping behavior 2: maintaining social support and psychological stability	36.55 (5.92)	25–47	54
Coping behavior 3: communication with medical staff	14.90 (3.10)	8–23	24

study to which the results of these studies could be applied were motor and speech delay, and possibly feeding difficulties. No significant results were found with respect to increasing levels of severity of motor or speech delay.

A study performed by Hodapp et al. (1998) evaluating stress and coping in parents of children with Smith-Magenis syndrome (SMS) found that levels of stress were predicted by the size of a family's support system and the degree to which the child's condition impaired his or her socialization. Autism was one socialization feature of children assessed in this study. Results demonstrated no significant differences among functioning and coping mechanisms for parents of children with varying degrees of autistic features, therefore were not consistent with the results obtained from Hodapp's study.

Studies show conflicting opinions about the impact of marital status on coping and family functioning. Various studies have demonstrated that couples with a disabled child are more prone to lower levels of marital satisfaction and higher divorce rate due to higher levels of role strain and conflict with child-rearing, fewer positive spousal interactions, and the return of the family to traditional gender roles in parents of children with chronic conditions (Bristol et al. 1988; Gray 2003; Quittner et al. 1998; Tew et al. 1974). Conflicting results have arisen in other studies that have reported no differences in marital satisfaction or even positive effects, such as greater closeness, in parents of children with disability (Barbarin et al. 1985; Quittner et al. 1998). However, this study did not include questions specifically addressing questions of role strain, marital satisfaction, or division of caregiving tasks, so results from this study can only comment on the percentage of parents of children with PTLS who are married and how much they rely on their spouse as part of their coping strategy. Several items in the coping section of the questionnaire specifically addressed the participant's spousal relationship, with coping behaviors such as "Building a closer relationship with my spouse" and "Talking over personal feelings and concerns with my spouse." Of these coping mechanisms, trusting one's spouse for support was the most frequently used, followed by building a closer relationship with one's spouse. Global judgments could be made based on the high percentage of responders who were mothers; however this may not be an accurate reflection of the division of child-care labor and should not be considered a result of the study.

Results of this study are consistent with similar studies indicating that couples of children with chronic conditions do not have higher rates of divorce and consider their partners supportive (Barbarin et al. 1985; Grootenhuis and Last 1997). Future studies involving this cohort of parents could incorporate measures of specific sources of strain, if any, to improve the type of targeted care provided to parents of children with PTLS.

Overall functioning and coping scores were compared to scores of other studies that used the same instruments to assess parents of children with chronic illness. Varni et al. (2004) used the PedsQL Family Impact module in a study comparing functioning levels of parents of children with cerebral palsy or severe birth defects who received care in a convalescent home versus in the parent's home. The results of this 2004 study found that parents of children receiving care through the convalescent home had higher levels of functioning when compared to those whose children received care at home. When overall scores from this study were compared to parents of children with PTLS, functioning scores of parents in this study were below those of parents caring for children with cerebral palsy or severe birth defects in their home in the majority of dimensions. Another study by Scarpelli et al. in 2008 used this instrument to measure the differences in parental functioning in parents whose children had been diagnosed with cancer and were receiving care as either in-patients or out-patients. The

Table 5 Free responses from parents on raising a child with PTLS

"Big one!!!! Never stops!" - In response to PedsQL statement *"I worry about my child's future*"

"Especially as she gets older."—In response to PedsQL statement *"I worry about how others will react to my child's condition"*

"[My child] is the first child in Holland (if not Europe) that is diagnosed with PTLS."—In response to CHIP coping behavior *"Believing that the medical center/hospital has my family's best interest in mind"*

"No one knows about PTLS here!"

"Our family doctor is not educated on PTLS."—In response to CHIP coping behavior *"Talking with my doctors about my concerns about my child with the medical condition"*

"[The local healthcare providers] don't know anything about PTLS and out geneticist put [our child] through a full year of testing after he should have known her diagnosis."—*General comment at end of survey*

parents of children who were in-patients had higher functioning scores than those caring for their children at home with the exception of the "Daily Activities" subscale (Scarpelli et al. 2008). The scores of the parents of children with PTLS consistently fell between the scores of the two groups in the majority of the dimensions; parents of children with PTLS scored below parents of out-patient children in the dimensions of Social and Cognitive Functioning and Communication.

Comparisons were also be made between CHIP coping scores of parents in this study and those of parents of children with chronic illness in a study by McCubbin et al. (2001). The individuals in our study indicated very similar levels of satisfaction with the use of the strategies of integration, cooperation, and optimism, and the use of medical communication and consultation. The parents in our study find the coping strategy of maintaining social support, self-esteem, and psychological stability more helpful than parents of children with chronic illness. These comparisons provide a point of reference with regard to how parents of children with PTLS are functioning and coping in relation to their peers. In general, the parents in our study report levels of functioning that are similar to or lower than parents of children with chronic health conditions, and cope with their child's medical condition with comparable strategies.

Common themes were observed from previous studies assessing stress in parents of children with rare genetic syndromes. Griffith et al. (2011) studied the psychological well-being of parents with children diagnosed with Angelman, Cornelia de Lange, and Cri du Chat syndromes, three rare conditions that share similar behavioral features (intellectual disability and behavior problems). They concluded that parents of children diagnosed with rare genetic diseases are at increased risk for higher stress levels and mental health issues, potentially related to stressors such as more frequent medical issues and procedures and difficulty in finding knowledgeable providers (Griffith et al. 2011). Weng et al. (2011) noted the paucity of data on caregiver stress with regard to rare genetic disorders and young children in their qualitative study exploring family member experience with children diagnosed with Russell-Silver syndrome (RSS). Major themes of care-giving distress identified in this study included endless psychological worries, lengthy process to confirm a medical diagnosis, and adjusting family roles (Weng et al. 2011). Similar concerns were evident in parents of children with PTLS and were appreciated through their free responses (Table 5). Results of our study add to the body of knowledge pertaining to well-being of parents of children with rare genetic syndromes. While it does not focus specifically on the stressors associated with the rarity of PTLS, it can be appreciated that parental functioning is impacted by severity of clinical features in a condition made unique by its variable expression, low prevalence, and recent characterization.

Study Limitations

There is a potential ascertainment bias of this population because in order to be listed in the database from which parents were recruited, that person would have to be involved in PTLS research or have taken the initiative to contact the PTLS study coordinator at BCM. Therefore, the population surveyed was likely comprised of parents who are actively involved in PTLS research. Even among these parents, it is possible that lower functioning families did not have the opportunity to return the survey and therefore were under represented. Additionally, the majority of this population was comprised of Caucasian, married, well-educated, and financially-stable women. Generalization of functioning and coping scores are limited by the homogeneity of the group, as scores for more affluent families may be influenced due to better access to resources and services, as well as the small sample size of 29 participants.

Another potential limitation is the subjectivity of disease severity which was reported by the child's parent. Specific criteria within each category were included as a guide for parents, but this is subject to the parent's recollection and knowledge of the defects. Severities of features such as motor and speech delay are defined by the age at which delay was identified, so this could be subject to recall bias by the parent.

This study did not identify how long the parent had known about the diagnosis and the child's current age. Due to the anonymity of the surveys this was not information that could be obtained after data collection. It is possible that length of time the diagnosis has been known is associated with parental functioning and coping. This type of information could be beneficial in providing more targeted care to parents based on where they are in the time line of receiving the diagnosis. In addition, the instrument used for assessing parental and family functioning is validated for children ages 2 through 18. The database of participants indicates that the majority have children within this age range, however the questionnaire was anonymous and therefore it could not be entirely ruled out that some children fell outside the acceptable range. If so, the functioning scores for these participants may not be considered valid.

Lastly, by setting the alpha at 0.05 in this exploratory study, the likelihood of spurious results is increased.

Research Recommendations

As more children are diagnosed with PTLS, the opportunities to learn more about different aspects of this condition will arise. Future research on families with PTLS should include the use of multiple sites to improve applicability and

sample size, identify the current age of the child or length of time diagnosis has been known, as well as address the functioning and coping of parents over time as children with PTLS enter adolescence and young adulthood to determine if these levels change in relation to the child's age.

One potential study could compare the parent's perception of the child's disease severity to a severity assessment performed by a clinical geneticist experienced with these patients. This could be done by removing the criteria provided to the participants of this study as guidelines for their child's degree of severity, i.e. just having the options of absent, mild, moderate, and severe without any further description. The parent would then have to indicate where they feel their child falls on the severity scale. Information identifying the child to whom the parent is linked would be kept, so that the geneticist could review that child's medical chart and make his or her own severity assessment. Comparisons could then be made between the reports of the parent and the medical specialist. Results from this potential study could provide valuable information on how perceptions differ between parents and providers, and how such perceptions influence levels of functioning and coping. A future study may also explore the relationship between parent reported family size and hours spent with a child and parental coping and well-being.

Advancements in genetic testing technology will likely lead to scenarios similar to that experienced by parents of children with PTLS: a new genetic aberration is identified and suspected to be causative, the condition is characterized as the number of diagnoses increases, and while the family is given an etiology for their child's findings they also face an exceeding amount of uncertainty regarding this recently described, rare condition. Future research may focus on recruiting larger samples of parents in this situation to better understand sources of caregiver distress, allowing healthcare providers to improve education and communication to facilitate the adaptation process. Consistent, overarching needs of these parents may be identified or may vary from condition to condition.

Conclusions

Results of this study suggest that the degree of severity of clinical features of PTLS impacts parental functioning, specific to the features of feeding difficulties and cardiovascular defects. Results from this study will be important in creating a foundation for future quality of life studies of parents of children with PTLS. Information obtained from the participants of this study can also be integrated into the care provided to these families with current diagnoses and those who receive a diagnosis in the future. The healthcare team, being aware of the presence and degree of severity of the features examined in this study, may be able to tailor routine care to the needs of parents, perhaps suggesting focused therapy or family counseling as well as specialized genetic counseling to improve parental well-being.

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