Published in final edited form as:

Am J Med Genet A. 2007 March 1; 143(5): 484–487. doi:10.1002/ajmg.a.31502.

Deaths Due to Choking in Prader-Willi Syndrome

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Abstract

Prader-Willi syndrome (PWS) is the most common known syndromic cause of life threatening obesity, yet few studies have examined the causes of death in PWS. The objective of this study was to examine the contribution of choking leading to mortality in PWS. In 1999, a brief survey was made available from the Prader-Willi Syndrome Association (USA) bereavement program, which documented demographic data and causes of death. Families were subsequently offered the opportunity to fill out a detailed questionnaire and additional forms to release medical records. Demographic information was available on 178 deceased individuals with PWS, and cause of death available on 152 individuals. Fifty-four families completed questionnaires. Of the deceased individuals with completed questionnaires, 34% reported a history of choking. Choking was listed by familial report as the cause of death in 12 (7.9%) of 152 subjects with an average age of 24 years (range 3–52y; median 22.5y) at death from choking. Only two of these individuals were less than eight years of age. The data suggest that risks associated with choking are different in the PWS population compared with normal. Potential causes of increased choking in PWS include poor oral/motor coordination, poor gag reflex, hypotonia, hyperphagia, decreased mastication and voracious feeding habits. We recommend implementation of preventive measures and education for families and group home care providers for all individuals with PWS including the Heimlich maneuver, supervised meals, better food preparation and diet modification to avoid high risk choking items.

Keywords

Prader-Willi syndrome; choking; aspiration; mortality; sudden death; vomiting

INTRODUCTION

Prader-Willi syndrome (PWS) is a common genetic disorder with a prevalence of approximately 1 in 10,000–20,000 individuals [Butler 1990; Hertz et al., 1993]. The underlying genetic etiology is the absence of expression paternally derived genes located in the chromosome 15q11-q13 region. Clinically, PWS is characterized by central hypotonia particularly in infancy, developmental delay, cognitive impairment, hypogonadism, and obesity due to hyperphagia in early childhood [Cassidy and Ledbetter, 1989].

PWS is the most common known syndromic cause of life threatening obesity, yet few studies have examined the causes of death in PWS. Early mortality and unexpected sudden deaths have been reported in PWS [Nagai et al., 2005; Schrandt-Stumpel et al., 2004; Smith et al., 2003; Stevenson et al., 2004; Wharton et al., 1997], but choking has not been previously reported as a frequent cause of death. The contribution of obesity to mortality in PWS is commonly discussed as subsequent to cardiorespiratory failure [Hertz et al., 1993; Laurance et al., 1981; Reske-Nielsen and Lund, 1992; Smith et al., 1998], but we hypothesize that the food related behaviors leading to obesity also put individuals with PWS at risk for mortality from aspiration/choking.

METHODS

The Prader-Willi Syndrome Association (USA) developed a bereavement support program for families who voluntarily contact them after death of a family member. Families subsequently receive supportive bereavement information twice in the first year and then once again in the second year. In 1999, a brief survey was created to document demographic information and cause of death by familial report. In 2001, consistent tracking of all participants of the program began by the bereavement coordinator.

Given the apparent increase in mortality and unexplained deaths in PWS, the Prader-Willi Syndrome Association (USA) organized a subspecialty committee including a cardiologist, gastroenterologist, endocrinologist, medical geneticist, and a volunteer patient advocate representative to investigate deaths in PWS. In 2004, this committee developed a questionnaire to obtain perceived relevant information regarding demographics, medical history, cause of death, and circumstances around the time of death. Families were contacted and subsequently offered the opportunity to fill out this questionnaire and release medical records including autopsy reports if available.

RESULTS

Data were available from familial report on 178 individuals from the brief survey established through the bereavement program. The median and average age at death was 27 years and >25% of individuals were <19 years. The cause of death was reported in 152 individuals. Respiratory compromise or pneumonia was reported as the cause of death in 24% while choking was reported as the cause in 12 (8%) of the 152 individuals. Deaths were reported as unexplained in 27 (18%) of the 152 individuals.

Questionnaires were completed by 54 families. The average age of death in this subset was 31.4 years with a median of 32.5 years and ranging from one to 55 years. The average weight at death was 100.3 kg. Clinical features from familial report when response was given of this cohort included: high pain threshold (90%), hypotonia (87%), sleep apnea (63%), temperature instability (59%), and thick saliva (50%). Gastrointestinal history when response was given included: 6% required the Heimlich maneuver at one point in time; 34% had a history of choking; 79% had a report of decreased vomiting during viral illnesses compared to familial perception of others with a similar viral illness. Additional information

is as follows: 32% died at home; death was reported as sudden in 70% and unexpected in 78%; only three individuals were reported as receiving growth hormone (GH) therapy at the time of death (ages 22y, 17y, and 1y); ten individuals had taken GH at one time in the past; and autopsies were available for review in eight of the 54 subjects and gastritis was reported in three of eight subjects.

Detailed information was not available on all 12 of 152 individuals reported to have died due to choking. Table I includes the summary information for each death. Of those who died due to choking, 11 of 12 were of male gender and the average age at death from choking was 24 years (median 22.5 years; range 3–52 years).

DISCUSSION

The most vulnerable period for choking in the pediatric period is reported between 1–4 years of age [Hayes and Chidekel, 2004; Tarrago, 2000]. A retrospective review of foreign body aspiration reported that children with neurological impairment were older with a higher incidence of complications [DeRowe et al., 2002]. Similarly in our cohort, the average age of death of those who died due to choking was 24 years and only two individuals were less than eight years of age. In the adult population alcohol and/or drugs, poor dentition, and parkinsonism are often contributing factors [Mittleman, 1984; Mittleman and Wetli, 1982], which did not seem to be prevalent in our study. This suggests that other factors contribute to the aspiration risk in the Prader-Willi syndrome population.

The well documented history of hyperphagia and voracious feeding habits seen in PWS would place this patient population at risk for food asphyxiation. In particular, the food associated behaviors including food foraging, stealing of food, and the consumption of inedible foods contribute to choking susceptibility. In addition, hyperphagia may also lead to decreased mastication. Three individuals in our series were in the act of stealing food when the choking event occurred. The act of stealing food leads to quicker consumption with further decreased mastication to avoid negative consequences.

Viscous saliva and decreased volume have been associated with PWS. Stimulation of salivary flow was documented as 3-fold lower in an analysis of 25 subjects with PWS in one report [Hart, 1998], and familial perception of thick saliva was reported in 50% of deceased subjects in our cohort who completed questionnaires. The viscous saliva and decreased volume may contribute to difficulty with mastication and swallowing predisposing them to choking especially in combination with increased appetite or events of food foraging.

Generalized hypotonia of the pharyngeal musculature may also lead to swallowing difficulties, and poor oral/motor coordination has been anecdotally reported [Scheimann et al., 2006]. Although generalized hypotonia may be a predisposing factor to aspiration, hypotonia is most prominent in the neonatal period but we did not observe any choking fatalities in individuals less than two years of age. The lack of neonatal choking in our cohort was probably due to the lack of high risk choking items in the diet during this period. Of note, the high frequency of pneumonia and respiratory compromise in our study may be secondary to unrecognized aspiration. Hypotonia, however, does continue to be a persistent feature in PWS and likely contributes to the risk of choking.

Decreased vomiting was subjectively reported as a frequent finding in our study (79%) and has been previously reported in subjects with PWS [Alexander et al., 1987]. The etiology is unknown, although a combination of vagal autonomic dysfunction, hypotonia, and a poor gag reflex may be contributing factors. The underlying factors contributing to the observed decrease in vomiting likely contribute to difficulty in protecting the airway.

From our entire cohort of individuals with PWS, gastritis was incidentally found on autopsy in 3/8 individuals in which autopsies were available. Gastritis could slow down gastric emptying and predispose to rumination or gastroesophageal reflux. A prior survey conducted by Alexander et al. [1987] found that 10–17% of individuals with PWS had a self-reported history of rumination. Additionally, increased abdominal girths in individuals with PWS may predispose to increased intragastric pressure and gastroesophageal reflux [El-Serag et al., 2006]. The presence of gastroesophageal reflux and esophagitis are predisposing factors to the development of esophageal food impactions in the general population [Lao et al., 2003] and likely translates to individuals with PWS. Therefore, treatment with H2-blockers or proton pump inhibitors may be beneficial to some individuals with PWS.

Interestingly, death from choking was observed primarily in individuals of male gender in our cohort (11 of 12 subjects). Male gender in the general population is cited as a risk factor for choking, with one pediatric study reporting the male/female ratio as 1.4/1 [Hayes and Chidekel, 2004; Mittleman, 1984]. The male/female ratio in our study is much higher but the numbers are small and will need further validation to determine the contribution of gender to the risk of choking in individuals with PWS.

In our cohort of all individuals with PWS who completed the questionnaire, (not just those who died secondary to choking), 6% required the Heimlich maneuver at one point in time. In only one case was the Heimlich maneuver reported as unsuccessful. Heimlich maneuver training for group home PWS caregivers and families may reduce mortality. Other potential preventative measures include meal supervision (especially during holidays and special occasions in which food seeking behaviors may increase due to the change in environment and circumstances), and diet modification to avoid high risk choking items.

The majority of data was obtained through familial report and confirmed when available through medical records. There is therefore a potential bias on perceived cause of death from familial report. Still, our data suggest that individuals with PWS are medically vulnerable with early mortality. A combination of features likely contributes to this vulnerability, including choking and aspiration. As we dissect specific contributors to morbidity and mortality in the PWS population, we will be able to further identify strategies to improve their quality of life and longevity.

Acknowledgments

We thank the Prader-Willi Syndrome Association (USA) and participants for their support. This research was supported by a grant from the Prader-Willi Syndrome Association (USA), NIH RR-00064, NIH K23 NS052500, and the Children's Health Research Center and Clinical Genetics Research Program at the University of Utah.

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Table 1

Deaths Due to Choking

Patient	Age (years)	Gender	Food Item	Other Information
#1	3	male	hotdog	dislodging food item by parent unsuccessful
#2	3.5	male	cracker	"choked during asthma attack."
#3	8	male	hotdog	stole food at relative's house
#4	10	male	not available	
#5	18	male	not available	
#6	22	male	not available	fell asleep while eating
#7	23	male	"chicken nugget"	stole food item during holiday
#8	32	male	not available	previous choking episode
#9	35	male	not available	previous choking episodes; in group home
#10	42	male	not available	Heimlich maneuver not successful
#11	44	female	not available	in group home; choked while out to lunch with staff members
#12	52	male	"large piece of meat"	stole food item from garbage