Impact of the Swallowing Dysfunction and Gastroesophageal Reflux on Nutritional Status of Children with Cerebral Palsy

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Abstract:

Undernutrition is a frequent problem in children with cerebral palsy who often have significant impairment of the eating and swallowing mechanism. A prevalence of oropharyngeal dysfunction and gastroesophageal reflux (GER) in 30 preschool children with cerebral palsy (CP) was studied using videofluoroscopy with barium contrast. The relation of their feeding dysfunction to their nutritional status was evaluated. Seventeen of these children had spastic tetraplegia, 10 had cerebral diplegia and only 3 had hemiplegia. Five children (16.7%) of our sample had no feeding dysfunction, they all had mild functional motor impairment and topographically, they had diplegia; 83.3% of these children had feeding dysfunction. Of these, 44% had combined dysfunction, 28% had isolated swallowing defect and 28% had isolated GER. Evidence of respiratory infection was present in 7 patients during radiological examination. Malnutrition, defined as triceps skin fold thickness (TSF) less than the third percentile for age and sex, was present in 50% of the cases. We found negative correlation between the degree of severity of cerebral palsy and both TSF and weight standard deviation score (r: -0.867, r: -0.748 respectively). Children with combined swallowing defect and GER had the lowest mean TSF and weight standard deviation score (3.26 ± 0.52 mm and -3.4 ±0.87 respectively). These findings were statistically significant (F = 2.83 and 3.12 respectively).

This study showed the value of using videofluoroscopy for assessment of feeding dysfunction in children with cerebral palsy. Assessment of secondary malnutrition and feeding dysfunction should be regarded as an important part of their general care. A multidisciplinary team should carry out this assessment.

Introduction:

Cerebral palsy (CP) is the commonest cause of physical disability in children. It occurs in 3 to 4 per 1000 live births, and one third of these children are severely affected.¹¹ Undernutrition is a frequent problem in children with cerebral palsy who often have significant impairment of their eating and swallowing mechanism.¹² The effect of undernutrition on physiologic brain growth and on development is well recognized, so their neurologic development is significantly impaired.¹³ Pseudobulbar palsy, which occurs in severe CP, affects eating and swallowing.¹⁴ Gastro-esophageal reflux (GER) often compounds the problem. It is probably related to abnormal peristalsis, lower esophageal sphincter dysfunction and delayed gastric emptying.¹⁵ Pharyngeal dysphagia and gastroesophageal reflux put the child at risk of repeated episodes of aspiration.⁶ Safe, efficient swallowing is a complex act requiring the coordination of six cranial nerves, the brain stem, cerebral cortex and 26 muscles of the mouth, pharynx, and esophagus.⁷,⁸ Swallowing consists of two voluntary phases (oral preparatory and oral) followed by two reflex phases (pharyngeal and esophageal). Each phase depends on the phase preceding it, but in children with CP this sequence may be disrupted.⁹ Common difficulties are poor head control, inability to close the mouth, reflex tongue thrust, delayed or absent swallowing reflex, and diminished pharyngeal peristalsis.¹⁰ Other contributing factors are communication difficulties and poor hand function so they are unable to feed themselves.¹¹

The prevalence of feeding difficulties and failure to thrive among the children with cerebral palsy is uncertain.¹²,¹³ Poor methodology had resulted in estimates that varied substantially with the population examined.

We undertook this study to ascertain the extent and nature of feeding difficulties in children with spastic type cerebral palsy and the relation of such difficulties to their nutritional status.

Subjects and Methods:

Thirty children with a confirmed diagnosis of spastic type cerebral palsy aged between 6-66 months were included in our study. They are attending the Pediatric department in Alhayat Hospital, Jeddah,
KSA, between January 1998 and May 1999. Their neurologic status was assessed according to the Standard Recording of Central Motor Deficit. The type and distribution of CP were categorized according to the distribution proposed by Hagberg et al.

A detailed feeding history was taken from the parents or caregivers about the child’s feeding skills and the main difficulties. The following questions guided the assessment of the child’s feeding ability:

- What were the child’s eating and drinking mechanics? Could he or she suckle? If older, could he or she eat with a spoon? Could the child close lips properly? Could the child drink with a cup?
- How did the child deal with saliva?
- How long did it take the child to take liquids and solids of different consistencies?
- How much of a problem of vomiting, regurgitation? Was there coughing or choking during feeding?
- What was the child's eating position during and after feeding?
- Had the child ever required admission to hospital for pneumonia? Was there any evidence of food aspiration or recurrent respiratory symptoms as stridor, wheeze, or respiratory distress?

Examination of the children involved:

- Orofacial examination: careful attention paid to ophthalmoplegia, structural abnormalities of the jaw, tongue or palate, a pharyngeal gag reflex, and the presence of a jaw jerk. Abnormal oral, pharyngeal or laryngeal movement such as tongue thrust or the inability to form a bolus or chew.
- Chest examination to assess if the child had respiratory infection or wheezes.
- Assessment of the child’s anthropometric measurements, we measured weight, height (or length) and compared the results with growth charts. We converted the weights to standard deviation score (SDS) values related to age and gender specific means and standard deviation. Muscle mass and body fat estimated by measuring upper arm circumference and triceps skin fold thickness (TSF).

Radiological assessment by videofluoroscopy: the examination involved the parents, the pediatrician, and the radiologist. We seated the children in a tumble-form chair in their normal feeding position and use their own feeding utensils. Swallowing was assessed with food of different thickness and textures, rendered opaque with barium. The food that normally best tolerated was given first in gradually increasing volumes. Swallowing was visualized fluoroscopically using the lateral position to show the sequence of movements from the lips, jaw, tongue, and oropharynx to the upper part of esophagus. We recorded the timing and coordination of the swallow reflex and in those without normal triggering, the degree of pharyngeal distension required to produce an effect. Swallowing efficiency was also evaluated by assessing residual contrast in the mouth and pharynx after each swallow. (Fig. 1)

The presence of gastroesophageal reflux was recorded (Fig. 2). We evaluated the presence of any associated abnormalities such as hiatal hernia, esophageal stricture, tracheo-esophageal fistula, achalasia, or vascular compression. We paid attention to whether the contrast is aspirated into the tracheobronchial tree or nasopharynx before, during, or after the swallow reflex. As aspiration can occur silently if there is an inadequate cough reflex, we were particularly interested in whether the child coughed if contrast was aspirated. Patients who had gastroesophageal reflux by videofluoroscopy were reconfirmed by admission and having a pH monitoring of the acid reflux in distal esophagus using twenty-four hour esophageal pH probe.

Statistical analysis was undertaken with the SPSS/PC program for windows, version 7.5. Analysis included mean and standard deviation. For categorical data, non-parametric tests were employed. P value < 0.05 was considered significant.

Results:

Characteristics of the sample: This study was done on 17 boys and 13 girls (aged 6 to 66 months; mean age 31.8±17 months). Of these, 37% had severe functional motor impairment, 33% had moderate impairment, and 30% were in the mild group. Seventeen patients (57%) had tetraplegia, 10 patients had cerebral diplegia (33%), and only 3 patients had hemiplegia. (Tables I & II).

Feeding defects: We classified feeding dysfunction observed during the study into: swallowing defects, (including abnormal swallowing reflex and bolus formation with any form of palato-phalangeal dysphagia), gastroesophageal reflux, and combined dysfunction (both swallowing defect and gastroesophageal reflux).

Feeding dysfunction was present in 83.3 % of studied children. Of these, 44% had combined dysfunction, 28% had isolated swallowing defect and 28% had isolated gastroesophageal reflux,
however gastroesophageal reflux was present in 60% of all cases. Feeding dysfunction was present in each category of cerebral palsy. Combined dysfunction was more commonly encountered (65%) in association with tetraplegia, whereas 50% of diplegic children had no feeding dysfunction. All of them had mild form of functional motor disability. Children with hemiplegia who represents only 10% of the cases were insufficiently well represented to draw any firm conclusions.

Combined feeding dysfunction was found in 64% of children with severe functional motor impairment and in 40% of cases with moderate motor impairment.

**Nutritional status:**
Children with combined dysfunction had the lowest mean of TSF $(3.26 \pm 0.5 \text{ mm})$, mid-arm circumference $(127 \pm 10.3 \text{ cm})$, and weight-SDS ($-0.34 \pm 0.87$), followed by children with gastroesophageal reflux (table III). We used weight-SDS instead of weight percentiles because about 40% of the children had their weights below the third percentile. $F$ value for TSF and weight SDS was statistically significant (2.83 and 3.12 respectively). There was significant reverse correlation between the degree of severity of cerebral palsy and both weight-SDS and TSF ($r: -0.748$ and $-0.867$ respectively), by Pearson correlation. Patients with severe motor impairment had the least TSF and weight-SDS means $(3.08 \pm 0.24 \text{ mm and } -3.98 \pm 0.75$ respectively), while children with mild impairment had no signs of undernutrition. Their weight-SDS and TSF were $(-0.49 \pm 0.9$ and $7.7 \pm 1.67 \text{ mm respectively})$ (table IV).

**Risk of aspiration:**
Frequent coughing and choking were present in 60% of children, 20% had weak cough reflex to the aspirated contrast. Chest infection was observed in 7 patients during videofluoroscopy. Residual pooling of food in the pharynx and pyriform sinuses was present in 44.5% of the patients.

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![Fig 1. Delayed descent of ingested barium through hypopharynx.](image1)

![Fig 2. Evidence of gastro-esophageal reflux by barium swallow.](image2)
Table I: Distribution of CP children topographically and according to the type of feeding dysfunction.

<table>
<thead>
<tr>
<th>Topographic distribution of patients</th>
<th>Total</th>
<th>Type of feeding dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n</td>
</tr>
<tr>
<td>C.P. diplegia</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Tetraplegia</td>
<td>17</td>
<td>0</td>
</tr>
<tr>
<td>Hemiplegia</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

GER = Gastroesophageal reflux.

Table II: Distribution of the CP children according to the severity of functional motor impairment and the type of feeding dysfunction.

<table>
<thead>
<tr>
<th>Distribution of patients according to severity</th>
<th>Total</th>
<th>Type of feeding dysfunction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None</td>
</tr>
<tr>
<td></td>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Mild</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Moderate</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Severe</td>
<td>11</td>
<td>0</td>
</tr>
</tbody>
</table>

GER = Gastroesophageal reflux.

Table III: Distribution of patients according to the type of feeding dysfunction and some anthropometric measurements.

<table>
<thead>
<tr>
<th>Type of feeding dysfunction</th>
<th>No.</th>
<th>Weight (Kg)</th>
<th>Weight * SDS</th>
<th>TSF* (mm)</th>
<th>Mid-arm Circumference (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>5</td>
<td>14.46 ± 1.46</td>
<td>0.2 ± 0.19</td>
<td>9.1 ± 0.29</td>
<td>139 ± 3</td>
</tr>
<tr>
<td>Swallowing defect</td>
<td>7</td>
<td>12.82 ± 3.2</td>
<td>-2.1 ± 1.26</td>
<td>5.2 ± 1.2</td>
<td>135 ± 6.9</td>
</tr>
<tr>
<td>GER</td>
<td>7</td>
<td>10.34 ± 2.99</td>
<td>-3.09 ± 1.3</td>
<td>3.37 ± 0.5</td>
<td>130 ± 5.3</td>
</tr>
<tr>
<td>Combined dysfunction</td>
<td>11</td>
<td>9.96 ± 2.6</td>
<td>-3.4 ± 0.87</td>
<td>3.26 ± 0.5</td>
<td>127 ± 10.3</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>11.47 ± 3.1</td>
<td>-2.47 ± 1.6</td>
<td>4.76 ± 2.2</td>
<td>131.6 ± 8.6</td>
</tr>
</tbody>
</table>

*P value < 0.05

Table IV: Distribution of the patients according to the severity of CP and some anthropometric measurements.

<table>
<thead>
<tr>
<th>Degree of severity of CP</th>
<th>No.</th>
<th>Weight (Kg)</th>
<th>Weight SDS</th>
<th>TSF (mm)</th>
<th>Mid-arm Circumference (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>9</td>
<td>13.14±2.6</td>
<td>-0.49±0.9</td>
<td>7.7±1.67</td>
<td>136±6.3</td>
</tr>
<tr>
<td>Moderate</td>
<td>10</td>
<td>11.56±2.6</td>
<td>-2.5±0.87</td>
<td>3.96±0.72</td>
<td>132±4.9</td>
</tr>
<tr>
<td>Severe</td>
<td>11</td>
<td>10.01±3.4</td>
<td>-3.98±0.75</td>
<td>3.08±0.24</td>
<td>127±11.15</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>11.47±3.1</td>
<td>-2.44±1.6</td>
<td>4.76±2.2</td>
<td>131±8.6</td>
</tr>
</tbody>
</table>

Weight-SDS = Weight standard deviation score, TSF = Triceps skin fold.

Discussion:

For many parents of handicapped children, feeding represents the major difficulty in the daily management of their children. More than 80% of our sample of preschool children with cerebral palsy had clinically significant oropharyngeal and/or esophageal dysfunction with about 40% of them having combined dysfunction, and 60% having gastro-esophageal reflux. Our findings were slightly
lower than those of Reily et al.;(19) 66% of their children were classified as having severe deficit, while only 37% of our representative sample had severe impairment. Skuse et al.(20) and Couriel et al.(21) reported closer results to our study. Tetraplegia was more associated with combined dysfunction; and GER was present in 82.5% of these children. High incidence of GER in patients of tetraplegic cerebral palsy was observed by Booth,(22) Sondheimer et al.,(23) Lewis et al. (24) and Fried et al.(5) Delayed gastric emptying is an important factor in GER in spastic cerebral palsied children older than three years.(5,23)

In our study, we found that combined dysfunction was more prevalent in severe functional motor impairment group. The same observation was recorded by Rielly et al.(19) They found that severe oral motor dysfunction was prevalent in severe and profound cerebral palsy group. In general, the more severe the functional motor disability, the more severe was the feeding defect.

Many children with severe neurodevelopmental disease exhibit malnutrition and growth retardation. It is often evident from infancy and worsens with age. Many factors contribute to poor growth. A direct neurological effect on growth is controversial. Inadequate nutrition is undoubtedly important. Children with mild cerebral palsy who can walk are not usually malnourished, however, very dependent disabled children are underweight, with wasted muscles and reduced skinfold thickness.(11) Objective measurements of growth are required to assess the adequacy of nutrition. The usual definition of wasting (reduced weight for height) may be inappropriate because of the inherent difficulty in accurately measuring length in tetraplegic patients with severe body habitus distortion.(26) The denervation of skeletal muscles results in atrophy; similarly malnutrition causes wasting of skeletal muscles and adipose tissue. However, there is no evidence that the neurodevelopmental disability per se affects adipose tissue, so, skin-fold measurements is considered now the most useful method of assessing nutritional status in cerebral palsied patients.(27) TSF was less than the third percentile in about 50% of studied children and the lowest mean TSF was recorded in cases of combined dysfunction of feeding which indicates the deleterious effect of feeding problems on the nutritional status in such children.

Videofluoroscopy helped us to observe, in more detail, how the child coped with small amounts of various foods, the seating position used during feeding, and the duration to eat mouth-full. Griggs et al.,(28) used fluoroscopy to identify safer types of foods and positions for feeding. We noticed that children could eat more easily when they are well seated. Adaptive seating maintains upright posture and may improves head control, retention of the food in mouth, and eating skills.(29) Feeding depends on coordination of swallowing and breathing. The child with impaired swallowing has a poorly protected airway and is at greater risk of aspiration. Aspiration at the beginning of a feed, before swallowing has occurred, suggests poor tongue control or an abnormal swallowing reflex. Aspiration during swallowing indicates failure of laryngeal closure. Aspiration can follow swallowing with inhalation of residual food from the pharynx or secondary to gastroesophageal reflux. Other factors such as immobility, weak respiratory muscles, poor cough, and impaired immune defense because of malnutrition predispose these children to respiratory illness.(30) Sixty percent of our sample had respiratory complaints as frequent coughing and wheezes with evident respiratory infection in 7 patients during radiological examination. Rielly et al.(19) reported respiratory complications in 50% of their cases.

Conclusion and Recommendation:

- Many of children with cerebral palsy have dysmotility evidenced by palatopharyngeal incoordination, gastroesophageal reflux, delayed gastric emptying and constipation. A better understanding for this problem and its management is needed.
- Videofluoroscopy with barium contrast is helpful for assessment of feeding dysfunction, and for diagnosing respiratory complications in these children.
- Secondary malnutrition due to feeding dysfunction should be treated or ideally prevented. Restoring the nutrition of these children should be regarded as an important part of their general care.
- In children with mild disabilities, oral motor skills should be maintained and improved.
- Detailed assessment for each cerebral palsied child proved to be worthwhile as it has reassured the parents and helped them to clearly understand how to deal with their children. This is best carried out by a multidisciplinary team. Such an approach can significantly reduce the stress of feeding and result in a substantial improvement in the quality of the health and life of the child and his family.

References: