Evaluation of Swallowing in Infants with Congenital Heart Defect

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Abstract

Introduction Surgical repair of congenital heart disease in the first years of life compromises the coordination of the suction, breathing, and swallowing functions.

Objective To describe the alterations in swallowing found in infants with congenital heart defect during their hospitalization.

Methods Prospective, cross-sectional study in a reference hospital for heart disease. The sample consisted of 19 postsurgical patients who underwent an evaluation of swallowing. The infants included were younger than 7 months and had a diagnosis of congenital heart defect and suspected swallowing difficulties.

Results Of the 19 infants with congenital heart defect, the median age was 3.2 months. A significant association was found between suction rhythm and dysphagia \( (p = 0.036) \) and between oral-motor oral feeding readiness and dysphagia \( (p = 0.014) \).

Conclusions The data suggest that dysphagia often occurs after surgery in infants with congenital heart defect. Infants with congenital heart defect had very similar behavior to preterm infants in terms of oral feeding readiness.

Introduction

Congenital heart defect is defined as a malformation of the heart or blood vessels that develops during the fetal period. The prevalence is 9:1,000 live births, corresponding to 1.35 million newborns per year. Most of these children require surgical intervention, often in early childhood.

The multiple surgeries to correct the heart defect are debilitating and often hinder the quality of life. The presence of chromosomal abnormalities, cyanosis, and heart failure increase the complexity and challenge involved in the treatment. The life expectancy of patients with congenital heart defect has increased due to advances in early diagnosis, care after birth, and surgical techniques. However, with improved survival, new challenges have arisen in the growth and development of these children.

In childhood, oral feeding is established as a reciprocal process, one that is essential in the life experience of young children. Swallowing is a complex process that involves neurologic and aerodigestive coordination. Neurobehavioral markers, such as postural control, regulation of the sleep-wake cycle, and maturation of coordination of the suck-swallow-breathe process, provide the clinical picture necessary for the child to advance toward oral feeding readiness.

Newborns with congenital heart defect may require a prolonged hospital stay, well beyond the neonatal period, during the most important period of development. In the long term, this could affect somatic growth as well as cognitive and...
social-emotional growth. Among these infants, THE nutri-
tional condition resulting from the inability to feed often 
leads to an imbalance in energy intake, resulting in impaired 
growth.\textsuperscript{11} Due to compromised cardiopulmonary function, 
these infants may need a longer time to feed or may present 
with a lack of appetite and food refusal.\textsuperscript{12} Feeding difficulties 
may not be combined with oropharyngeal dysphagia.\textsuperscript{13}

In pediatrics, oropharyngeal dysphagia may have a varied 
clinical presentation, depending on its etiology, complexity, 
and impact on the lives of patients with feeding difficulties.\textsuperscript{14} 
It is often observed in children with various medical diagnos-
esc,\textsuperscript{15} and it may be caused by several conditions, such as 
cerebral palsy, cleft lip or palate, and other structural abnor-
malities.\textsuperscript{16} in addition to congenital heart defect. Dysphagia 
not only deprives one of the pleasure of eating, but also 
edangers health,\textsuperscript{17} because it could lead to the development 
of complications, including impaired growth,\textsuperscript{18} chronic aspi-
ration, lung disease,\textsuperscript{18,19} malnutrition,\textsuperscript{17} and others.

The aim of this study was to describe the swallowing 
alterations found in infants with congenital heart defect 
evaluated during their hospitalization period.

**Methods**

This prospective, comparative, cross-sectional study was 
conducted at the Pediatric Intensive Care Unit at the Institute 
of Pediatric Cardiology in Porto Alegre, Brazil, from August 
2011 to August 2012.

The inclusion criteria were as follows: infants under 
7 months, diagnosed with congenital heart defect and with 
suspected swallowing disorders were included in the study. 
Infants with a neurologic or syndromic medical diagnosis, or 
awaiting surgical correction, were excluded from the research.

This study used a protocol to characterize the sample, the 
Preterm Oral Feeding Readiness Assessment scale,\textsuperscript{20} and a 
protocol for the clinical evaluation of swallowing based on 
the study by Weir et al.\textsuperscript{21}

The protocol for the clinical evaluation of swallowing had 
the following information: date of birth, gender, medical 
diagnosis, date of the cardiac surgery, time of the mechanical 
ventilation.

The Preterm Oral Feeding Readiness Assessment scale 
was used in this study. According to Fujinaga et al.,\textsuperscript{22} this 
instrument is divided into five categories: (1) corrected 
gestational age (\(\leq 32\) weeks: 32 to 34 weeks, and \(\geq 34\) 
weeks); (2) behavior state (state of conscience, posture, 
and global tonus); (3) oral posture (lips and tongue posture); 
(4) oral reflexes (rooting, sucking, biting, and gag 
reflexes); (5) nonnutritive sucking (tongue movement, 
tongue cupping, jaw movement, sucking strength, 
sucking pauses, pause per sucking, maintenance of sucking 
rythm, maintenance of alertness, and stress behavioral 
signs). Performance in every item is graded on a scale from 
0 to 2 points, with a total score that varies from 0 to 36 
points. However, the first category was not considered in 
our study.

In this evaluation, the infants were placed on their moth-
er’s lap to assess oral posture, oral reflexes, and nonnutritive 
sucking. Verification of oral reflexes was performed using a 
gloved finger and/or a pacifier.

The clinical evaluation occurred through breast- or bottle-
feeding. The infant who had previous experience of breast-
feeding was evaluated at the first moment in breast-feeding, 
and if necessary afterward with a bottle. The first oral assess-
ment using either bottle- or breast-feeding occurred after 
application of the Preterm Oral Feeding Readiness Assessment 
Scale. The bottle evaluated was filled with liquid and thickened 
liquid consistencies, and we observed coordination of sucking, 
swallowing, and breathing and presence of oral stasis, cough, 
fatigue after feeding, cyanosis, and desaturation. After swal-
lowing evaluation, the sample was divided into two groups to 
compare the clinical findings for each group. The infants with 
normal swallowing comprise group 1 and those who had 
oropharyngeal dysphagia comprise group 2.

The study was approved by the Research Ethics Committees 
of the Universidade Federal do Rio Grande do Sul Postgraduate 
Program and of Instituto de Cardiologia, under registration No. 
2010064 and No. 4603/11, respectively. Consent was obtained 
from the guardians before the study was conducted.

The database and the analyses were performed using SPSS 
version 19 (Statistical Package for the Social Sciences, New York, 
US). Fisher exact test was used to assess the association between 
groups and other qualitative variables. The nonparametric 
Mann-Whitney test was used to compare the duration of 
mechanical ventilation between the groups, and the Spearman 
test was used to correlate oral-motor readiness with the time of 
mechanical ventilation. Qualitative data were described as ab-
solute and relative values. Qualitative variables were expressed 
through median, minimum, and maximum values. The present 
study adopted a significance level of \(p = 0.05\).

**Results**

Demographic and cardiac characteristics of patients are shown in 
Table 1. Out of the 19 infants in the sample, 11 (58%) were 
boys. The median age was 3.2 months (minimum = 0.3, 
maximum = 6.2). Twelve infants had acyanotic congenital 
heart defect, and seven had cyanotic congenital heart defect.

Oropharyngeal dysphagia was identified in 16 (84%) of the 
infants under study. The most common clinical finding was 
the lack of suck-swallow-breathe coordination \((p \leq .001)\) 
which was observed in combination with oral leaking in 5 
infants; stasis in the oral cavity in 4; cough during feeding in 
5; fatigue during feeding in 4; desaturation in 3; and cyanosis 
during feeding in 1. Descriptions of the clinical evaluation and 
scoring of Preterm Oral Feeding Readiness Assessment Scale 
are described in Table 2.

During the evaluation of readiness for oral feeding, no 
association was found between absence of sucking rhythm 
and the presence of oropharyngeal dysphagia \((p = 0.036)\). 
However, 12 (63%) infants with oropharyngeal dysphagia 
presented arrhythmic sucking, and all infants with normal 
swallowing presented rhythmic sucking. There was no rela-
tion of sucking/pause and dysphagia between the groups. The 
comparative distribution between the two groups, regarding 
the variables, is shown in Table 3.
The group of infants with normal swallowing and the group with oropharyngeal dysphagia had a median 24 and 48 hours in mechanical ventilation, respectively. There was no correlation between the duration of mechanical ventilation and the oral readiness score. Spearman correlation was $r = -0.349$.

Fig. 1 shows a comparison of performance in the readiness for oral feeding protocol between the group of infants who had normal swallowing and the group of infants who had oropharyngeal dysphagia. The group of infants with normal swallowing had a median score of 33 (minimum = 30, maximum = 36) and the group of infants with oropharyngeal dysphagia had a median score of 25 (minimum = 16, maximum = 33). The correlation between oral-motor readiness and dysphagia was $p = 0.014$.

**Discussion**

The present study showed that infants with congenital heart defect have low scores on the evaluation of readiness for oral feeding, which are very close to those of preterm infants. It should be underscored that the evaluation of readiness for preterm infants differs from the evaluation of infants with congenital heart defect, because the coordination of the suck-swallow-breathe process improves with the maturation of the central nervous system in cases of preterm birth.

The mean values for the oral-motor readiness scores found in this survey were 25 for the group of infants with oropharyngeal dysphagia and 33 for the group of infants with normal swallowing. These results show that oral-motor skill is associated with oropharyngeal dysphagia and that the assessment of readiness before clinical evaluation is extremely important.

By exploring possible variables that could affect the performance of swallowing, we found that the duration of mechanical ventilation did not influence the oral-motor readiness or the outcome of the clinical evaluation. This finding diverges from the literature, which states that oropharyngeal dysphagia may occur after mechanical ventilation and after prolonged intubation.

### Table 1 Demographic characteristics of cardiac patients

| Case no. | Gender | Age     | Cardiac diagnosis                                      | Type of cardiology | Surgical repair | Intubation time (h) | Extubation failed |
|----------|--------|---------|--------------------------------------------------------|--------------------|-----------------|---------------------|------------------|
| 1        | F      | 5 mo 1 d| Complex cyanotic congenital heart disease              | Cyanotic           | Yes             | 1,536               | Yes              |
| 2        | F      | 28 d    | Pulmonary stenosis                                     | Acyanotic          | Yes             | 456                 | Yes              |
| 3        | F      | 6 mo 7 d| Interventricular communication                          | Acyanotic          | Yes             | 4                   | No               |
| 4        | F      | 4 mo 2 d| Aortic stenosis                                        | Acyanotic          | Yes             | 2.5                 | No               |
| 5        | M      | 3 mo 9 d| Aortic coarctation                                     | Acyanotic          | Yes             | 24                  | No               |
| 6        | M      | 3 mo 2 d| Total anomalous pulmonary venous drainage              | Acyanotic          | Yes             | 48                  | Yes              |
| 7        | M      | 20 d    | Aortic coarctation and aortic stenosis                  | Acyanotic          | Yes             | 144                 | No               |
| 8        | M      | 19 d    | Aortic stenosis                                        | Acyanotic          | Yes             | 336                 | Yes              |
| 9        | M      | 3 mo 3 d| Pulmonary atresia and atrial septal defects             | Cyanotic           | Yes             | 216                 | Yes              |
| 10       | M      | 4 mo 2 d| Atrial septal defects, interventricular communication and aortic coarctation | Acyanotic  | Yes             | 960                 | Yes              |
| 11       | M      | 15 d    | Transposition of great vessels                         | Cyanotic           | Yes             | 9                   | No               |
| 12       | M      | 4 mo 17 d| Interventricular communication                        | Acyanotic          | Yes             | 192                 | No               |
| 13       | F      | 10 d    | Aortic stenosis                                        | Acyanotic          | Yes             | 24                  | No               |
| 14       | M      | 5 mo 25 d| Interventricular communication, patent ductus arteriosus, and aortic coarctation | Acyanotic  | Yes             | 288                 | Yes              |
| 15       | F      | 15 d    | Pulmonary atresia                                      | Cyanotic           | Yes             | 168                 | No               |
| 16       | M      | 2 mo 10 d| Atrial septal defects, interventricular communication, and patent ductus arteriosus | Acyanotic  | Yes             | 48                  | No               |
| 17       | F      | 4 mo 24 d| Tetralogy of Fallot                                     | Cyanotic           | Yes             | 24                  | No               |
| 18       | M      | 16 d    | Transposition of great vessels                         | Cyanotic           | Yes             | 168                 | No               |
| 19       | F      | 4 mo    | Tetralogy of Fallot                                    | Cyanotic           | Yes             | 648                 | Yes              |
Clinical evaluation showed that in infants with congenital heart defect, oropharyngeal dysphagia is characterized by a lack of coordination of the suck-swallow-breathe process, whether or not this is combined with stasis of food in the oral cavity, cough, anterior leaking, and fatigue during breast-feeding. It is known that oropharyngeal dysphagia may occur in young children due to fatigue of the swallowing mechanism. Moreover, oral feeding requires muscle strength to extract the milk from the bottle or from the mother’s breast and coordination of the suck-swallow-breathe process; also, infants with congenital heart defect are likely to resist ingesting the total prescribed volume, due to surgical intervention, which hinders weight gain and growth of these newborns and infants.

Among the pediatric population with heart disease, risk factors for oropharyngeal dysphagia as follows: age under 3 years, preoperative intubation, intubation greater than 7 days, and operations for obstructive injuries on the left side. The use of transesophageal echocardiography in children weighing less than 5.5 kg is considered a predictor of...
dysphagia.\textsuperscript{27} However, clinical evidence of oropharyngeal dysphagia in infants investigated postoperatively in this research emphasizes that dysphagia may take place with intubation times of less than 7 days.

Kohr et al aimed to determine the incidence and risk factors for oropharyngeal dysphagia in children after cardiac surgery and found that oropharyngeal dysphagia occurred in 9 (18\%) of the 50 patients.\textsuperscript{27} The videofluoroscopic findings were as follows: 7 (78\%) cases of delayed triggering of swallowing; 2 (22\%) cases of laryngeal penetration, with direct aspiration and vocal fold paralysis; 2 (22\%) cases of occasional laryngeal penetration without aspiration; 1 (11\%) case of laryngeal reduction; and 2 (22\%) cases of direct aspiration resulting from vocal fold paralysis. Sachdeva et al,\textsuperscript{28} whose objective was to evaluate the impact of voice disorders and feeding in children after cardiac surgery, showed that swallowing dysfunction was observed in 34 (89\%) children with vocal fold alterations. The swallowing examination was performed in 29 patients with congenital heart defects, \textasciitilde{}30 days after surgery. The most common pathophysiological finding was aspiration, which was observed in 23 (80\%) children. Laryngeal penetration occurred in 5 of them (17\%), and delayed triggering of swallowing in only 1 (3\%). Through instrumental evaluation, researchers were able to identify oropharyngeal dysphagia in this population of children with congenital heart defects.

Yi et al performed a retrospective study in which the objective was to evaluate the prevalence and clinical predictors of dysphagia and determine the videofluoroscopic findings of swallowing in children who underwent cardiac surgery.\textsuperscript{29} Through videofluoroscopic findings, the authors concluded that 67.9\% of the children had laryngeal penetration and 63.6\% had tracheal aspiration, and of these 85.7\% of symptoms were silent, without the presence of cough. In our clinical study, we also observed a low incidence of cough during swallowing. Only 4 of the 16 infants identified with oropharyngeal dysphagia showed cough while swallowing.

Our results corroborate the studies by Kohr et al,\textsuperscript{27} Sachdeva et al,\textsuperscript{28} and Yi et al,\textsuperscript{29} which showed that oropharyngeal dysphagia often occurs postoperatively in infants, as most infants who had corrective surgery presented oropharyngeal dysphagia, even with thickened liquid. Thickening of food is a procedure adopted to minimize the pattern of dysphagia.\textsuperscript{27}

It is important to note that feeding problems are common among children with congenital heart defect.\textsuperscript{6,11,27–31} According to Arvedson,\textsuperscript{13} feeding difficulties are characterized by refusal, disruptive behavior, preference, and lack of feeding competence expected for the subjects’ level of development. Newborns who were born with a serious heart condition requiring heart surgery in the first month of life have a high risk of presenting feeding difficulties until 2 years of age.\textsuperscript{30} The speech therapist should be aware of these behaviors during the evaluation of swallowing.

The results of the present study suggest that dysphagia often occurs in infants after corrective surgery for congenital heart condition. The use of the preterm readiness for an oral feeding protocol enabled us to verify that infants with congenital heart defect may present with very similar behavior to those of preterm newborns.

### Conclusion

In the present study, the occurrence of oropharyngeal dysphagia in infants under 7 months of age with congenital heart defect was observed, and the same finding was detected by clinical evaluation. Infants with congenital heart defect showed a very similar behavior to that of preterm newborns. However, oropharyngeal dysphagia is a variable that still needs to be further studied to determine the epidemiologic data and identify the best clinical management outcome among this population.
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