INFORMATION TO USERS

This reproduction was made from a copy of a document sent to us for microfilming. While the most advanced technology has been used to photograph and reproduce this document, the quality of the reproduction is heavily dependent upon the quality of the material submitted.

The following explanation of techniques is provided to help clarify markings or notations which may appear on this reproduction.

1. The sign or “target” for pages apparently lacking from the document photographed is “Missing Page(s)”. If it was possible to obtain the missing page(s) or section, they are spliced into the film along with adjacent pages. This may have necessitated cutting through an image and duplicating adjacent pages to assure complete continuity.

2. When an image on the film is obliterated with a round black mark, it is an indication of either blurred copy because of movement during exposure, duplicate copy, or copyrighted materials that should not have been filmed. For blurred pages, a good image of the page can be found in the adjacent frame. If copyrighted materials were deleted, a target note will appear listing the pages in the adjacent frame.

3. When a map, drawing or chart, etc., is part of the material being photographed, a definite method of “sectioning” the material has been followed. It is customary to begin filming at the upper left hand corner of a large sheet and to continue from left to right in equal sections with small overlaps. If necessary, sectioning is continued again—beginning below the first row and continuing on until complete.

4. For illustrations that cannot be satisfactorily reproduced by xerographic means, photographic prints can be purchased at additional cost and inserted into your xerographic copy. These prints are available upon request from the Dissertations Customer Services Department.

5. Some pages in any document may have indistinct print. In all cases the best available copy has been filmed.

University Microfilms International
300 N. Zeeb Road
Ann Arbor, MI 48106
Positioning and physiologic changes during feeding of infants with congestive heart failure secondary to congenital heart disease

Korpon, Mary Lou, M.S.
The University of Arizona, 1988
PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark √.

1. Glossy photographs or pages ______
2. Colored illustrations, paper or print ______
3. Photographs with dark background ______
4. Illustrations are poor copy ______
5. Pages with black marks, not original copy √
6. Print shows through as there is text on both sides of page ______
7. Indistinct, broken or small print on several pages √
8. Print exceeds margin requirements ______
9. Tightly bound copy with print lost in spine ______
10. Computer printout pages with indistinct print ______
11. Page(s) ________ lacking when material received, and not available from school or author.
12. Page(s) ________ seem to be missing in numbering only as text follows.
13. Two pages numbered _______. Text follows.
14. Curling and wrinkled pages ______
15. Dissertation contains pages with print at a slant, filmed as received ______
16. Other ____________________________________________________________

__________________________________________

__________________________________________

___________________________

UMI
POSITIONING AND PHYSIOLOGIC CHANGES DURING
FEEDING OF INFANTS WITH CONGESTIVE HEART
FAILURE SECONDARY TO CONGENITAL HEART DISEASE

by

Mary Lou Korpon

A Thesis Submitted to the Faculty of the
COLLEGE OF NURSING
In Partial Fulfillment of the Requirements
For the Degree of
MASTER OF SCIENCE
In the Graduate College
THE UNIVERSITY OF ARIZONA

1988
STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his/her judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: Mary Ann Koppert

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

J. Keenan Casteel
Assistant Professor of Nursing

June 2, 1982
DEDICATION

To Mom and Dad....

I know you would have been proud.
ACKNOWLEDGMENTS

The author has been assisted in the completion and writing of this thesis by several people. A sincere thank-you is extended to the following:

Dr. J. Keenan Casteel, Chairperson - whose patience, helpful suggestions, and constant availability are immeasurable;

Dr. Joyce Verran and Dr. Lee Crosby, committee members - for their assistance and guidance;

Dr. Marie Lobo - who encouraged me to pursue my graduate education;

Dr. Sally Lambert - without whom data collection would have been very difficult;

My siblings - whose encouragement and long distance phone calls provided much support;

The nurses at Rainbow Babies and Childrens Hospital - for their support and participation in the study; and finally,

The Nellcor Corporation - who very generously donated the pulse oximeter.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF ILLUSTRATIONS</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>8</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>9</td>
</tr>
</tbody>
</table>

## CHAPTER

### I. INTRODUCTION

- Statement of the Problem | 10  
- Statement of the Purpose | 12  
- Definitions of Terms | 13  
- Significance of the Problem | 14  
- Conceptual Orientation  | 14  
  - Environmental Experiences | 17  
  - Adaptation | 18  
  - Human Physiologic Response | 19  
  - Synopsis | 20  
- Summary | 21  

### II. REVIEW OF THE LITERATURE

- Positioning and Pulmonary Functioning | 22  
- Physiologic Alterations in Cardiopulmonary Functioning Associated With Feeding | 26  
- Summary | 31  

### III. METHODOLOGY

- Design | 33  
- Setting | 33  
- Sample | 33  
- Protection of Human Subjects | 34  
- Data Collection | 35  
  - Equipment | 36  
  - Procedure | 37  
- Pilot Study | 40  
- Data Analysis | 40  
- Assumptions | 41  
- Limitations | 41  
- Summary | 42  


### TABLE OF CONTENTS—Continued

<table>
<thead>
<tr>
<th>IV. RESULTS AND PRESENTATION OF DATA</th>
<th>43</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic Characteristics of Study Sample</td>
<td>43</td>
</tr>
<tr>
<td>Characteristics of Feeding Behaviors</td>
<td>45</td>
</tr>
<tr>
<td>Statistical Analysis of the Physiologic Variables</td>
<td>47</td>
</tr>
<tr>
<td>Case Presentations</td>
<td>55</td>
</tr>
<tr>
<td>Relationship Among Study Variables</td>
<td>74</td>
</tr>
<tr>
<td>Similarities and Differences in Behaviors and Physiologic Parameters</td>
<td>76</td>
</tr>
<tr>
<td>Summary</td>
<td>77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>V. DISCUSSION OF THE RESULTS</th>
<th>79</th>
</tr>
</thead>
<tbody>
<tr>
<td>Findings Related to the Conceptual Framework</td>
<td>79</td>
</tr>
<tr>
<td>Findings Related to the Research Questions</td>
<td>81</td>
</tr>
<tr>
<td>Physiologic Considerations of the Data</td>
<td>81</td>
</tr>
<tr>
<td>Methodological Difficulties</td>
<td>84</td>
</tr>
<tr>
<td>Applications to Nursing Practice</td>
<td>84</td>
</tr>
<tr>
<td>Recommendations For Future Research</td>
<td>86</td>
</tr>
<tr>
<td>Summary</td>
<td>87</td>
</tr>
</tbody>
</table>

APPENDIX A: HUMAN SUBJECTS APPROVAL | 89 |
APPENDIX B: PARENTAL AND NURSING CONSENT FORMS | 92 |
APPENDIX C: DATA COLLECTION FORM | 95 |
REFERENCES | 99 |
LIST OF ILLUSTRATIONS

<table>
<thead>
<tr>
<th>Figure</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Conceptual Framework</td>
<td>15</td>
</tr>
<tr>
<td>2.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject One</td>
<td>58</td>
</tr>
<tr>
<td>3.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Two</td>
<td>59</td>
</tr>
<tr>
<td>4.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Three</td>
<td>61</td>
</tr>
<tr>
<td>5.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Four</td>
<td>63</td>
</tr>
<tr>
<td>6.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Five</td>
<td>65</td>
</tr>
<tr>
<td>7.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Six</td>
<td>67</td>
</tr>
<tr>
<td>8.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Seven</td>
<td>69</td>
</tr>
<tr>
<td>9.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Eight</td>
<td>71</td>
</tr>
<tr>
<td>10.</td>
<td>Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Nine</td>
<td>73</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Selected Sample Characteristics</td>
<td>44</td>
</tr>
<tr>
<td>2.</td>
<td>Frequency of Behavior Observed Among Nine Infants During the Feeding Episodes</td>
<td>46</td>
</tr>
<tr>
<td>3.</td>
<td>Range, Median, Mean and Standard Deviation of Pre Feed Physiologic Variables</td>
<td>48</td>
</tr>
<tr>
<td>4.</td>
<td>Range, Median, Mean and Standard Deviation for the Physiologic Variables</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>During Feeding per Child</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Range, Median, Mean and Standard Deviation for the Physiologic Variables</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>During Feeding for the Group</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Range, Median, Mean and Standard Deviation For the Post-feed Physiologic</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td>Variables Per Child</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Post-feed Range, Median, Mean and Standard Deviation For the Physiologic</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>Variables For the Group</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Point Biserial Correlation Coefficients</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>For Feeding Positions and Physiologic Variables</td>
<td></td>
</tr>
</tbody>
</table>
A descriptive design was used in this study to describe the feeding behaviors (as defined by changes in body position) in infants with congestive heart failure secondary to congenital heart disease. In addition, short term physiologic changes associated with the behaviors were measured through the use of pulse oximetry and cardiorespiratory monitors. Nine infants were observed in this study as they were being fed by their nurses.

The method chosen was naturalistic observation. Descriptive statistics were used to analyze the demographic data and the measured physiologic variables. A point by serial correlation was conducted to describe any relationships between the position changes and the measured physiologic variables. Statistically significant relationships were found between certain positions and oxygen saturation, heart rate and respiratory rate.

The results indicate that infants do experience position changes that are accompanied by changes in physiologic variables during feeding. These position changes can be categorized as infant-mediated or nurse-mediated.
CHAPTER I

INTRODUCTION

Each year approximately 30,000 children enter the health care system in this country with a structural abnormality of the heart (Moller, 1982). Nutritional management of infants and children with uncorrected congenital heart disease (CHD) can present a difficult challenge for health care providers. Poor weight gain is especially common in infants with congestive heart failure (CHF) when fatigue and tachypnea interfere with adequate food intake. These children have acquired the reputation of being poor feeders and difficult to feed. Research directed at the feeding process may help health care providers to better understand the feeding experiences of these children.

Statement of the Problem

The present study focused on the problem of identification and description of feeding behaviors among infants with CHF secondary to CHD. This problem is illustrated by the following research questions: 1) what feeding behaviors, as defined by changes in body position, are exhibited by this particular group of infants? and 2) what, if any, are the short term physiologic changes associated with the behaviors as measured by pulse oximetry, heart rate, and respiratory rate?

Very little research has been conducted which addresses the issue at hand. In an effort to provide information useful to nurses
in evaluating the severity of cardiac malformations in newborns, Gillon (1973) recorded data on 82 infants with diagnoses of CHD. Among the infants with eating difficulties, she noted that after a few swallows, they pulled back from the nipple as though to catch their breath. Similarly, she observed a few dyspneic babies sucking from the bottle with their heads thrown back (necks hyperextended) and one who even slept in that position.

In a study which took place over two years, 10 infants under six months of age with small to medium ventricular defects were videotaped in an effort to describe distress cues and heart rate changes during feeding (M. Lobo, personal communication, August 31, 1987). Although back arching was found to exist among these infants, this behavior did not occur more frequently among the infants with CHD than the control group nor were the heartrate changes consistently associated with the back arching.

Physiologic changes occurring during position change have been the target of several studies. The prone position was found to be the optimum position for nursing care delivery because it significantly increases pulmonary function among populations of neonates, healthy premature infants, and low birth weight babies (Wagaman, Shutack, Moomjian, Schwartz, Shaffer & Fox, 1979; Hutchison, Ross & Russell, 1979; Schwartz, Fenner & Wolfsdorf, 1975). However, the position of the head in relation to the body rather than the body position itself was found to determine pulmonary function (Spoelstra & Srikasibhandha, 1973).
Of significance are the results of studies aimed at defining the effects of feeding on cardiopulmonary function. Feather and Russell (1970, 1974) found no significant changes in cardiorespiratory parameters in both full term and light for date term infants following feeding. In contrast, among healthy term infants and older preterm infants, bradycardia, apnea, hypoxemia, some cyanosis, significant reduction in ventilation, drops in transcutaneous oxygen levels, and deceleration of the heart rate were seen during the feeding process (Mathew, Clark & Pronske, 1985; Clark, Mathew, Pronske, Luna-Solarzano & Peterson, 1985; Luna-Solarzano, Clark, Peterson & Mathew, 1984; Guilleminault & Coons, 1984; Shivpuri, Martin, Carlo & Fanaroff, 1983; Winter, Samueloff, Cohen, Porges & Gross, 1966; Rosen, Glaze & Frost, 1984).

**Statement of the Purpose**

The purpose of this study was to identify and describe the behaviors of infants with CHF secondary to CHD during feeding and to determine if there are any short term physiologic changes associated with any particular behaviors. The investigator sought to confirm the existence of body position changes among these children during feeding - changes which have been informally documented by pediatric nurses. In addition, through the use of pulse oximetry and cardiorespiratory monitors, the investigator wanted to determine the relationship between oxygen saturation, heart rate and respiratory rate and any incidence of self-mediated body position changes.
Definitions of Terms

For the purpose of this study, the following terms were defined:

1. Infant: A child under six months of age.

2. Feeding Behaviors: Changes in body position in relation to the bottle. Of particular interest is hyperextension of the neck and arching of the back.

3. Short Term Physiologic Changes: Changes in oxygen saturation of the blood, heart rate, and respiratory rate occurring during the course of the feeding process.

4. Self Mediated: Voluntary actions performed by the infant without intervention of the nurse.

5. Congestive Heart Failure: A clinical syndrome characterized by circulatory congestion and decreased cardiac output. Circulatory congestion may involve the pulmonary circuit, the systemic circuit, or both. Symptoms include irritability or lethargy, fatigue during feeding and crying, and poor food intake. Signs are pallor, dusky skin, weak peripheral pulses, rapid breathing, wheezing and coughing, retractions and crackles, rapid heart rate, enlarged heart and liver, excessive sweating, edema, and slow weight gain (Waechter, Phillips & Holaday, 1985, p. 803).

6. Congenital Heart Disease: Any pathological disorder of the heart present at birth.

7. Pulse Oximetry: A photoelectric apparatus for determining the amount of oxygen in the blood.
8. Oxygen Saturation: Oxygen content of blood divided by oxygen capacity and expressed in volume percent. Measured by the Nellcor N-10 pulse oximeter.

**Significance of the Problem**

Nurses are primarily responsible for providing adequate nutrition for infants during hospitalization. Many pediatric nurses have noted some feeding behaviors of infants with CHF secondary to CHD that are of concern. Nurses need to identify and describe these behaviors and determine the existence of any physiologic changes associated with them. Much of the practice of pediatric nursing is based on assumptions or extrapolations from the research performed on adults and nursing must conduct research with children which ultimately may provide more efficient means to feed these children.

By attempting to identify and describe any behavioral changes that occur during feeding of infants with CHF secondary to CHD and measuring any physiologic changes that may occur during these behaviors, this study may contribute to knowledge directed at improving the feeding experiences of this group of infants.

**Conceptual Orientation**

Roy's Adaptation Model (1980) was used as a guide for the conceptual orientation of this study (Figure 1). Roy's model is viewed as a systems model that contains interactionist levels of analysis. The person as a patient is viewed as having parts or elements linked together in such a way that tension on the linkages can be increased or decreased. Increased tension comes from strains within the system
Environmental Experiences  
+  
Activities of Daily Living  
+  
Stressful Experience  
(feeding episode)  
+  
Infant Behavioral Adaptation to the Environment  
+  
Change in Body Position  
+  
Change in oxygenation Level  
+  
Oxygenation Level  
+  
Human Physiologic Response  
+  
Adaptation

---- tentative relationship

Figure 1. Conceptual Framework
or from the environment which impinges on the system. In order to adapt, the individual must respond positively to the forces that impinge upon his/her system.

Roy proposes that an individual's adaptation is influenced by the stimuli he/she is exposed to and his/her level of adaptation. Stimuli falls into one of three groups: 1) focal - stimuli immediately confronting the individual; 2) contextual - all other stimuli present; and 3) residual - beliefs, attitudes and traits that are relevant to the situation but difficult to measure objectively. Focal stimuli are everyday phenomena to which the individual must adapt. An example of a focal stimulus for the infant with CHD is an activity of daily living such as feeding.

Roy suggests that each individual's adaptation level is comprised of a zone. The zone depicts the necessary range of stimulation for a positive or adaptive response to occur. The stimulus must be within this zone for the individual to respond positively through his/her adaptive modes. The person is believed to have four subsystems or modes of adaptation: physiologic needs, self-concept, role function, and interdependence. The physiologic needs subsystem is the primary focus of this study.

Roy defines the goal of nursing as the promotion of adaptive responses in relation to the four adaptive modes. While nurses act by manipulating the impinging stimuli in order to promote adaptive responses, they also act to expand the person's adaptation level. Identification of behavioral responses as adaptive or ineffective is essential prior to manipulation of stimuli. The present study sought
to identify and classify feeding behaviors of infants. Once accomplished, this information can be used to determine the manner and amount of manipulation of the stimuli – otherwise known as nursing intervention.

The conceptual framework, derived from Roy's Adaptation Model (1980), was constructed from clinical experience, the literature, and conceptualization of the feeding experience. The constructs selected for this study – environmental experiences, adaptation, and human physiologic response – are grounded in physiology and nursing theory. Each of the three constructs and the corresponding concepts are described in the following sections.

Environmental Experiences

The term environmental experiences refers to all those events which occur as a result of an interface with the internal and external conditions and elements surrounding the individual. Roy (1980) proposes that people are bio-psycho-social beings in constant interaction with an ever changing environment, which includes physical, social, and psychological elements. The conceptual orientation for the present study focuses on activities of daily living.

The activities of daily living refer to those daily events which must be undertaken by the individual or provided to the individual by another in order to satisfy basic human needs such as hunger, cleanliness, and sleep. According to Roy's model, the individual is called upon to adapt in a positive fashion by performing these activities of daily living in an expedient and efficient manner.
In the present study, some of the activities of daily living can be classified as stressful experiences depending on the particular group in question. For many children with CHD, the feeding experience is one filled with stress - both physical and psychological. These children often tire very easily which necessitates more frequent feeds resulting in sleep deprivation - all of which produce stress.

Adaptation

The term adaptation refers to a positive response to a change. Roy (1980) proposes that an individual must respond positively to the ever changing environment in order to adapt. The individual uses both innate and acquired mechanisms for adaptation to the environment. As individuals are exposed to environmental experiences throughout life, they must respond with actions which lead to positive adaptation.

As stated previously, of the four modes of adaptation, this study focuses on the physiologic needs mode of infants with CHD. This mode is concerned with the structure of the body, its physical integrity, and how it functions. Infant behavioral adaptation to the environment refers to the ability to positively respond in a behavioral mode to an environmental condition/element which may be a source of stress. A change in body position is one mechanism for effecting adaptation in the physiologic mode. This alteration in body position refers to the process of changing position to enhance pulmonary function.

Infants with CHD have normal lung volumes and resistance to airflow, but a disturbance of the elastic properties of their lungs
(Howlett, 1972). Therefore any position change may have the potential of altering pulmonary function by affecting the elasticity of the infant's lungs. Such changes in positioning of the infant with CHF are self-mediated head turning or back arching. Although these positions have been informally noted by many pediatric nurses, the specific relationship to oxygenation has not been documented. Changing the position of the body to affect pulmonary functioning is a component of the physiologic needs mode.

One method of assessing the adaptive response of the cardiac infant to stressful events such as feeding is to document the frequency of self-mediated body position changes during feeding. Routine assessment during nursing care activities is a necessary component of the nursing process.

Human Physiologic Response

Human physiologic response refers to those physiologic responses which occur without our conscious knowledge. These responses can be adaptive or maladaptive although the body generally responds with a positive effort to correct a less than optimal situation.

The level of oxygenation has been identified by Roy (1980) as a basic physiologic need. Under normal conditions, an adequate arterial oxygen level results from the matching of ventilation to perfusion where ventilation is the movement of gas into and out of the pulmonary system while perfusion is the movement of blood through the capillary bed (Grosmaire, 1983). Pathologic changes in pulmonary function can alter the normal uneven distribution of inspired gas. These changes
can result from complete airway obstruction, increased resistance to gas flow, and regional changes in lung elasticity which alters regional lung compliance.

Changes in oxygenation level have been shown to be related to positioning, strenuous exercise, certain cardiorespiratory diseases, and high altitudes (Vander, 1975). These changes can represent increases or decreases in the measured values of oxygen level. Several methods provide accurate measurements of the level of oxygenation. Arterial blood gas analysis is perhaps the most precise measurement; however, it is invasive and often very painful, adding to an individual's stress. Transcutaneous oxygen measurement is the oxygen content of the blood passing beneath an electrode. This method provides an accurate measurement and although it is not invasive, use by an inexperienced person can produce severe burns of the skin surface. Pulse oximetry is the method of choice utilized in this study. By placing an adhesive sensor over a pulse site, the oximeter measures oxygen saturation of functional hemoglobin. It is a non-invasive method and can be used without disturbing the infant.

Synopsis

Using Roy's (1980) model as a guide for conceptual orientation, one can see that the environment and environmental experiences continually impinge upon the individual's system. Adaptation is the individual's response to the ever changing environment. Nursing care is directed toward supporting and promoting the individual's adaptation via the four adaptive modes. In order to support/promote the
individual's adaptation to stressful environmental experiences, the nurse must first ascertain whether the responses are of an adaptive or maladaptive (ineffective) nature. Once this classification is made, the nurse can direct the interventions at expanding the adaptation or providing positive responses aimed at dealing effectively with life's experiences.

**Summary**

Feeding infants with CHF secondary to CHD can be a stressful experience for the infant because of the exhaustion associated with the effort. The nurse expresses concern at not being able to provide them with adequate nutrition and promote growth and development.

The present study sought to identify and describe any behavioral changes – particularly body position changes – during feeding of infants with CHF secondary to CHD. In addition, measurements of oxygen saturation via pulse oximetry, heart rate, and respiratory rate were undertaken in an effort to associate any short term physiologic changes with behaviors exhibited by the infants.

Current practice of pediatric nursing could potentially be harmful or not in the best interests of the infant because a great deal of pediatric nursing care is based on assumptions or extrapolations from adult oriented research. Identification and description of behaviors and the physiologic changes occurring during feeding of infants with CHF secondary to CHD can be utilized by the nurse feeding these infants to enhance the experience and promote the nutritional intake of the infant.
CHAPTER II

REVIEW OF THE LITERATURE

In this chapter, the literature presented covers the following topics: 1) positioning and its relationship to pulmonary functioning and 2) physiologic alterations in cardiorespiratory functions associated with feedings.

Positioning and Pulmonary Functioning

"Respiration is influenced by body position and posture is known to affect neonatal lung mechanics, volumes, ventilation, and perhaps lung perfusion" (Hutchison et al., 1979, p. 429). Wagaman, Shutack, Moomjian, Schwartz, Shaffer and Fox (1979) designed a study to evaluate the effect of body positioning on arterial blood gases and lung mechanics. Arterial blood gases and lung mechanics were measured in 14 intubated infants recovering from neonatal respiratory disease while in the supine and two variants of the prone positions. Prone positioning resulted in significant increases in mean arterial oxygen tension, dynamic lung compliance, and tidal volume. The conclusions suggested that there are clinical benefits from prone positioning in neonates. This study speculated that the prone position would be most beneficial for: 1) patients with mild hypoxemia in whom a higher arterial oxygen level would be desirable and 2) infants with decreased lung compliance and tendency to develop atelectasis. Wagaman and associates utilized a cloth hammock prepared in such a way as to allow the head to remain
in the median position. The authors suggest that further investigations with the infant in the prone position and the head to the side could produce similar results and facilitate positioning and nursing care.

Twenty-three healthy newborns of which 10 were preterm and 13 were term but light for date were the subjects of a study by Hutchison, Ross and Russell (1979). In order to provide a guide for optimum nursing care position, the study was designed to quantify and contrast the effects of posture on ventilation and lung mechanics in two groups of infants of similar birth weight but of different maturity. The infants lay on a firm horizontal mattress in the right lateral, prone, and supine positions where the rotation of the head in the supine position was prevented by soft padding and turned to the left in the prone position. Tidal volume, esophageal pressure, dynamic lung compliance, and the work of ventilating were the variables measured in each position. Differences due to posture were noted only when the prone and supine positions were compared. In the preterm group, tidal volume, minute volume, elastic work, inspiratory and total viscous work, total work of breathing, and work of ventilating were significantly greater in the prone than in supine position. Posture had little influence on breathing in the light for date group despite the fact that esophageal pressure was lower and compliance higher in the prone position. According to the investigators, mediastinal contents caused compression of the esophageal balloon and produced the deceiving results. In this study, it was concluded that positioning in nursing care delivery is not an issue when providing care for healthy light for date infants; however, the prone position provided an improvement
in ventilation in the preterm group and is suggested as the optimum nursing posture for healthy preterm infants.

Similarly, Schwartz, Fenner and Wolfsdorf (1975) investigated the influence of the prone and supine body positions on the respiratory rate, arterial pH, pO₂, pCO₂, and serum bicarbonate levels, on alveolar pO₂ and pCO₂; and on alveolar/arterial gradients for carbon dioxide and oxygen in 10 low birthweight but healthy infants. Alveolar pCO₂ levels were greater in the supine position with no statistically significant differences noted in either position in the other parameters studied. No differences in respiratory rate were found although the rate increased in both positions. The authors felt that gas exchange is the most important variable to be examined in relation to positional changes. This study found that the significant decreases in alveolar pCO₂ and increases in alveolar pO₂ in the supine position suggest a ventilation/perfusion imbalance primarily involving an increase in physiological dead space. These results give physiological support to the practice of nursing in the prone position (Schwartz et al., 1975). Aside from the respiratory effects, several other advantages of the prone position are cited and decreased risk of inhalation of stomach contents is probably the most important.

In order to test the hypothesis that nursing in the prone position might offer better respiratory mechanical conditions, Spoelstra and Srikasibhandha (1973) measured the dynamic pressure - volume diagrams of the lungs in 17 healthy neonates in various positions. Dynamic pressure volume loops were measured as the difference between esophageal pressure - measured by an esophageal balloon at the end
of a feeding tube and pressure at the nostrils measured by a pneumotachograph connected to a nasal mask. Because initial results in changes in V/P loops between the positions were noted but not reproducible, attention was directed to the position of the head in relation to the body. A significant change was observed between rotation and median position of the head, but no significant changes were seen in the supine and prone position with the head in a median line. There was no difference between the loops obtained in the supine position with the head in normal position or with extension of the head; however, the slopes decreased when the head was flexed 45 degrees. Lying in prone position with the head in a median line produced a decrease while the V/P loops increased when the head was in the flexed position and normal when the head was in slight extension. Prone position causes a deformation of the upper airways because of the tendency to turn the head to one side. In the supine position, the infants tend to lie on one side—that is, the head in relation to the body is not greatly turned away from the median line. These observations, coupled with the V/P loop measurements, led to the conclusion that the prone position tends to result in inhibition of lung mechanics. Spoelstra and Srikasibhandha were careful to note that it is the relation of the head to the body, regardless of supine or prone positioning, which is the variable of most significance.

Helms, Hulse and Hatch (1982) were interested in detecting differences in lung volume and lung mechanics between the lateral and supine positions. Twenty-three infants and young children aged three weeks to 2½ years were the subjects of a study in which lung volume,
dynamic lung compliance and total pulmonary resistance were measured by plethysmography, air-filled balloons, and pneumotachography respectively. Fourteen of the subjects were studied under light sedation with chloral hydrate and the remainder were studied under general anesthesia. Some of the subjects had normal lung function while others had a variety of cardiorespiratory diseases. In the sedated group, no significant differences were found between the two positions for lung mechanics. The only variable that differed with position was dynamic lung compliance, being lower in the supine position and only among the anesthetized group. This study suggested that supine and lateral positions are equally suitable for measurements of lung volume and mechanics in most infants and young children. In those subjects with predominante unilateral lung disease, the supine position is considered the optimal one.

These studies have been reviewed because they imply a relationship between position and pulmonary function. Of those investigators able to determine statistically significant results, the prone position is considered the optimal one.

Physiologic Alterations in Cardiopulmonary Functioning Associated With Feeding

Changes in cardiorespiratory functions associated with feeding have been investigated in several studies utilizing premature, term, and light for date infants. These studies were primarily performed by physicians in large university teaching hospitals.

Russell and Feather (1970) reported no adverse effects on respiratory mechanics when measurements of tidal volume, esophageal pressure,
and the work of breathing were performed both prefeed and immediate post feed on 20 healthy full term neonates. Respiratory rate and minute volume were virtually unchanged while there was a nonstatistically significant rise in compliance and fall in viscous and total work following a feed. Russell and Feather (1970) attribute their results to the size of the feedings and amount of time taken to give the feeds. It is suggested that further studies must be undertaken to demonstrate the point at which adverse effects may appear taking into account the relative relationship between size of feeding and infant as well as maturity of the infant, time taken for a feed and the route by which it is given.

In 1974 Feather and Russell conducted another study of the effects of feeding on the respiratory mechanics in infants of low birth weight. Pressure was measured by means of an esophageal balloon connected with a micromanometer, volume was measured by electrical integration of the flow signal across a pneumotachygraph connected with a more sensitive micromanometer, and pressure and volume were recorded on a multichannel recorder. Compliance was calculated from the pressure and volume tracings of a series of 10 consecutive breaths which were also used to calculate the mean tidal volume, respiratory rate, and minute volume. While infants with appropriate weight for their gestational age showed an increase in compliance but not significant decrease in elastic and viscous work after feeds, these changes were not seen in the light for date infants. The results led to the conclusion that there was no evidence of any harmful effect of feeding on the respiratory mechanics of these infants.
Apnea, bradycardia, and cyanosis were noted during the oral feeding of 10 out of 50 healthy term infants who were studied while awake and supine in a semi-upright position (Mathew et al., 1985). Heart rate, nasal airflow, respiratory effort, and sucking pressures were continuously monitored via EKGs, flowmeters at the nose, respiratory inductive plethysmograph, and a modified standard nipple—all which were connected to a polygraphic monitor. Apnea and bradycardia were found to occur invariably at the beginning of the feed and resolution to occur spontaneously with continued feeding. These results suggest that some newborn infants may show an immature breathing pattern during feeding in the first few days of life.

The effect of oral feeding on the breathing pattern and ventilation was studied in 19 healthy term neonates in the semi-upright position (Clark et al., 1985). Ventilation was measured with a nasal flowmeter and sucking pressure via a modified nipple that permitted milk delivery. The feeding pattern in these infants consisted of an initial period of continuous sucking followed by intermittent sucking for the remainder of the feed. A significant reduction in minute ventilation was observed during continuous sucking and resulted from a reduction in breathing frequency. Tidal volume did not change but prolongation of expiration and shortening of inspiration were also observed. During intermittent sucking, the minute ventilation was similar to that of the control period. Smaller but significant changes in breathing frequency and in duration of inspiration and expiration persisted during intermittent sucking. A significant reduction in ventilation during the initial part of oral feeding in term neonates
and subsequent recovery with continued feeding was documented. Depending on the magnitude of this reduction in ventilation, it was felt that cyanosis and bradycardia may develop in some infants during oral feeding.

Luna-Solorzano, Clark, Peterson and Mathew (1984) monitored 12 term healthy one to three day old newborns during non-nutritive and nutritive sucking polygraphically to determine the effect of sucking. Heart rate, sucking pressures, nasal airflow, and respiratory efforts were monitored in the semi-upright position. During nutritive feeding, an initial burst of continuous sucking lasting 20-30 seconds was seen followed by intermittent sucking. Decreased breathing frequency and tidal volume as well as shortening of inspiration were seen during the initial period. A recovery towards control values was seen during intermittent sucking. In contrast, changes in breathing pattern were minimal during non-nutritive sucking. These results led to the conclusions that stimuli, related to either the presence of liquid in the upper airway or repetitive swallowing, rather than sucking per se, appears to be responsible for the inhibition of breathing seen during oral feeding.

Guilleminault and Coons (1984) described apnea and bradycardia during feeding in infants weighing greater than 2000 grams. They studied infants whose breathing, sucking, and swallowing were poorly coordinated and simultaneously recorded respiration with inductive plethysmography, airflow with thermistors, oxygen saturation using transcutaneous oxygen electrodes, and esophageal pH. Central apnea accompanied by rapid and significant bradycardia and decreased oxygen
saturation was recorded during the feeding with a steady maintained level of esophageal pH.

The effect of oral feeding on ventilation in 23 preterm infants of varying postconceptual age was the subject of a study by Shivpuri, Martin, Carlo and Fanaroff (1983). Ventilation was measured with a nasal mask pneumotachometer and sucking pressure via a nipple that also permitted milk delivery; transcutaneous \( pO_2 \) and \( pCO_2 \) were also monitored. The feeding pattern was similar to that seen in previous studies. Minute volume fell during continuous sucking in all the infants as a result of a decrease in respiratory frequency and tidal volume and was associated with a fall in transcutaneous \( pO_2 \). During intermittent sucking, minute ventilation and \( pO_2 \) recovered partially only in the more mature infants. This led to the conclusion that oral feeding results in an impairment of ventilation during continuous sucking and the subsequent recovery during intermittent sucking is dependent on postconceptual age.

In order to show that deceleration of the heart is a common and unique cardiovascular response of infants to suckle feeding, Winter, Samueloff, Cohen, Porges and Gross (1966) recorded EKGs on 135 healthy infants at rest and during feeding. Significant deceleration of the heart on swallowing was noted in 50 infants and found to occur regardless of sex, prematurity as measured by weight or age. When the initial heart rate was faster, deceleration of the heart tended to be more common and greater. Simultaneous recordings of respiration and heart rate in some of the infants indicated that the cardiac deceleration was coincidental with periods of apnea during swallowing.
Polygraphic monitoring studies were performed on more than 150 older preterm infants and full term neonates to evaluate unexplained or persistent apnea (Rosen et al., 1984). During polygraphic monitoring, 16 infants demonstrated hypoxemia during feeding. This feeding hypoxemia was accompanied by irregular respiratory effort and preceded any associated bradycardia. The infants with feeding hypoxemia showed evidence of CNS compromise as manifested by significant elevations of the maximum end-tidal carbon dioxide pressure. No relationship was found between feeding hypoxemia and sleep apnea or gastroesophageal reflux. The hypoxemia resulted from a reflex ventilatory depression or inhibition associated with feeding since interruption of the feeding resulted in prompt resumption of regular respiration. These authors felt that mild feeding disturbances may be more common than suspected; these changes may not be recognized because of the usual nursery practice of disconnecting monitoring equipment from "well" infants during feedings or because nurses remove the bottle frequently during feedings of preterm infants. It is suggested that all polygraphic recordings of infants aimed towards explaining persistent apnea should include recordings of nipple feedings.

Summary

This chapter presented a review of the literature pertinent to the present study. Positioning and pulmonary function and alterations in cardiorespiratory functions associated with feeding were the specific topics review in this section.
In general, changes in body position were found to affect pulmonary function. Specifically, the prone position was suggested as the optimal one for nursing care delivery in different populations of infants. However, because the present study involves the behaviors of infants while being bottle fed, these results are not helpful because the prone position is not conducive to bottle feeding. Many different changes in cardiorespiratory parameters were demonstrated during oral feeding episodes of infants. Overall, these changes involved respiratory mechanics. These studies were performed while the infants were fed in a semi-upright, supine position and did not indicate observations of any body position changes.

The present study attempted to integrate these two topics. The investigation involved the identification and description of feeding behaviors and consequent physiologic changes. Of particular interest were changes in body position in relation to the bottle as exhibited by the infants during feeding. The available literature presented gaps in that the research has not dealt with an integration of these topics.
CHAPTER III

METHODOLOGY

This chapter will present the research design and methods used in the collection and analysis of data in this study. Requirements for entry into the study and qualifications for data collection will be described.

Design

A descriptive design was employed to identify and describe the behaviors exhibited by infants with CHF secondary to CHD during the feeding process. In addition, any short term physiologic changes as measured by pulse oximetry, heart rate, and respiratory rate associated with the behaviors were described.

Setting

The setting chosen was a 220 bed Children's Hospital in a level III regional center located in a teaching hospital situated in a midwest United States metropolitan area. Children admitted to the hospital resided locally or were transported from within a multi-state area. The population represents several races and socioeconomic classes.

Sample

The convenience sample consisted of nine infants who had been admitted to the cooperating clinical agency for treatment of CHF. Criteria for subject selection were:
1. Consent from parents;
2. Infants six months of age or younger;
3. Bottle fed only (commercial formula or expressed breast milk);
4. Diagnosis of a cardiac anomaly such as cardiomyopathy, medium to large Ventricular Septal Defect, or Transposition of the Great Arteries which predisposes them to CHF as evidenced by the use of medications such as Digoxin, Lasix, or Aldactone.

Infants included in this study may have had surgery in the past but only of a palliative nature. In addition, children may have been hospitalized while awaiting corrective surgery or cardiac catheterization. Children with other congenital malformations which would directly affect the feeding process such as cleft lip/palate were excluded from the study. Also, any child requiring supplemental oxygen therapy was excluded.

**Protection of Human Subjects**

The research proposal, parental, and nursing consent forms were submitted to and approved by the University Human Subjects Committee and the Institutional Review Board For Human Investigation of the cooperating health care facility (see Appendix A). All parents and nurses were presented with a consent form which explained the study (see Appendix B). Confidentiality was maintained by assigning a code number to all of the infants and names of infants or parents were not collected.
Data Collection

Prior to data collection, the investigator reviewed the charts of the children to identify possible subjects for the study. In some cases, the pediatric cardiologists were consulted to confirm the eligibility of the infants. Once identified, every effort was made to contact the parents as soon as possible.

When contacted, parental consent was solicited for those infants meeting the criteria. Each parent or set of parents was approached individually and presented with an explanation of the study, shown the pulse oximeter, and encouraged to ask questions. Each parent was given the parental consent form (see Appendix B) and following verbal consent, the form was signed by a parent and witnessed by the principal investigator.

Once consent was obtained, demographic data was recorded from the chart and included date of birth, age at time of the study, sex, diagnosis, weight, and list of medications which were administered to the infant. This data was collected to insure that all subjects met the criteria and was recorded on part I of the data collection form (see Appendix C).

The nurse responsible for the care of the infant was informed about the study and asked to sign the consent form (see Appendix B). The research questions were presented and explained. The nurses were utilized to feed the infants in order to free the investigators to monitor the behaviors and physiologic parameters via naturalistic observation. Each nurse was instructed to feed the baby in the usual manner with the following exceptions: 1) the nurse was asked to begin the
feeding by holding the infant in the standard feeding position (semi-upright) and 2) the nurse was asked to allow the infant to assume any position that the infant desired and to offer the bottle to the infant in that position.

The data was collected once pre feed, every minute during the feed, and for five minutes post feed. The children were observed and measurements taken only during their regularly scheduled feedings.

Equipment

**Nellcor Pulse Oximeter (Model #N-10).** The Nellcor rechargeable pulse oximeter (model #N-10) was used to read the oxygen saturation (% $\text{SaO}_2$) of functional hemoglobin and the pulse rate. The percent saturation rate is 0-100% $\text{SaO}_2$ with an accuracy of +/-2 digits at 70-100% and +/-3 digits at 50-70%. The pulse rate range is 20-250 beats per minute (bpm). The Nellcor N-10 is designed to perform an internal calibration procedure with accuracies as described above (Nellcor Corporation, personal communication, October 2, 1987).

For this study, the spot check mode was used to measure the baseline $\text{SaO}_2$ and heart rate. The extended measurement mode provided a continuous display of $\text{SaO}_2$ and pulse rate with a printout every 30 seconds and was utilized during the feed and post feed.

**Spacelabs Cardiorespiratory Monitor.** Respiratory rate was measured by reading the alpha numeric display from the cardiorespiratory monitors utilized throughout the feeding episode. All the children were placed on Spacelabs cardiorespiratory monitors. Respiratory effort is monitored via the ECG electrodes through constant current impedance
pneumography. The range is 0–135 inspirations per minute (ipm) with an accuracy of 1% of the reading or 2ipm, whichever is greater (Space-labs Corporation, Operations Manual, 1983).

Procedure

Data collection during the feeding sessions was performed utilizing the naturalistic observation method with two recorders. This is a method whereby observations are recorded by an individual and that individual remains apart from the subject of the investigation. There is no attempt on the part of the investigator to enter or change the environment of the observee (Field & Morse, 1985).

Pre feed measurement procedure. The following activities were the responsibility of the principal investigator prior to the feeding sessions:

1) Selected infants who met the criteria. Obtained parental and nursing consent.
2) Recorded the demographic data and completed part I of the data collection form (see Appendix C). Assigned the infant a code number to insure confidentiality.
3) Verified with the infant's nurse the approximate time that he/she would begin feeding the infant.
4) Connected the infant to a Spacelabs cardiorespiratory monitor.
5) Placed the Nellcor pulse oximeter sensor on the infant's foot over a pulse site. Following application of the sensor, waited until the infant was in a quiet, alert state.
6) Obtained a baseline $\text{SaO}_2$ reading on the infant along with heart rate and respiratory rate approximately five minutes prior to the start of the feeding. Noted position of the baby and activity level and recorded all data in the pre feed section of part I – data collection form (see Appendix C). Made every effort to obtain data that was representative of an awake, alert, and quiet state. Pulse oximetry readings can be inaccurate if measured while the infant is crying.

**Feeding measurement procedure.** The principal investigator and the research assistant were responsible for the following activities during the feeding sessions:

1) The principal investigator asked the nurse to leave the cardiorespiratory monitor connected to the infant and in operation. The nurse was instructed to pick up the baby when the pulse oximeter printed a reading and the principal investigator called "now".

2) The principal investigator recorded the respiratory reading from the monitor at the moment when the pulse oximeter printed.

3) The assistant noted the infant's position and the caregiver activity at the signal from the investigator and recorded the data on the data collection form.

4) The assistant noted and recorded any infant position or caregiver activity which occurred during the one minute intervals.
5) The data was recorded every minute during the feed at the investigator's signal on part II of the data collection form (see Appendix C).

The feeding was over when the nurse put the baby back to bed, the infant consumed a predetermined limited amount, or the infant refused or was unable to consume any more of the feed.

The data collection was discontinued if the feeding process was interrupted (i.e., the infant was ordered to receive an X-ray) or if the infant experienced any coughing/choking spells that necessitated a pause in feeding greater than two minutes for resolution.

At the end of the feed, the nurse was asked to place the infant in its crib in a safe position (right lateral or prone) with the cardiorespiratory monitor in operation.

Post feed measurement procedure. The responsibilities of the principal investigator and the research assistant during the post feed measurement period were:

1) The principal investigator recorded the heart rate, respiratory rate and the percent oxygen saturation every minute for five minutes.

2) The assistant noted the position and activity of the infant and recorded every minute for five minutes at the investigator's signal.

3) All data was recorded on part III of the data collection form.
4) Immediately following the post feed data collection, both the investigator and assistant recorded a summary of any outstanding characteristics of each child on part II - data collection form.

Pilot Study

The investigator and research assistant (a graduate nursing student) conducted a pilot study of five subjects prior to actual data collection. The purposes of the pilot study were: 1) to train the research assistant in the naturalistic observation method; 2) to familiarize both investigators to the data collection form; and 3) to determine interscorer reliability for the subjective data of infant position and caregiver activity. The investigator and assistant recorded infant position and caregiver activity of the five infants for 10 minute periods during one feeding session for each of the five subjects. Percent agreement reached was 91.6% for infant position and caregiver activity.

Data Analysis

Descriptive statistics were used to analyze and characterize the feeding behaviors of the infants into meaningful sets. The range, median, mean, and standard deviations for each of the physiologic variables (%SaO₂, HR, RR) were calculated from the pre feed, feeding, and post feed data and presented in tabular form. Case presentations and corresponding graphs were presented for each child and the feeding experiences were reviewed to discover any similarities and differences among the group of infants. A point biserial correlation utilizing
time as a unit of analysis was conducted in an effort to describe a relationship between the positions and the physiologic variables.

Assumptions

The following general assumptions are recognized:

1) Behavioral changes during feeding would be manifested as changes in body position and could be described.

2) The nurses involved in the feeding of the infants understood and followed through with the given directives pertaining to this study (i.e., feeding should continue regardless of the infant's position unless the infant terminated sucking, consumed his/her established amount, or burping was necessary).

3) All equipment utilized (pulse oximeter and cardiorespiratory monitors) was operating correctly.

4) The pulse oximeter provided an accurate measurement of oxygen saturation and heart rate. The investigator was able to assess respiratory rate without disturbing the infant.

Limitations

1) Generalizations can only be extended to the sample studied.

2) The sample varied in age, severity of CHF, and ability to adapt to the CHF. Other physiological problems, pain fussiness, or interruptions could have altered the measurements observed.
3) The environment was not completely controlled (i.e., the investigator made no attempt to prohibit interruptions of the feeding process).

4) Data was collected at varying times following administration of medications which contribute to the control of the CHF.

Summary

This chapter described the development of a descriptive design to identify and describe behavioral changes which occur in infants with CHF secondary to CHD during feeding. Short term physiologic changes associated with the behaviors were determined through measurement of oxygen saturation via pulse oximetry, heart rate and respiratory rate. The setting, sample population, data equipment and procedures, methodology, assumptions and limitations of the study were presented as was the plan for analysis.
CHAPTER IV

RESULTS AND PRESENTATION OF DATA

This study was designed to describe the feeding behaviors (as defined by changes in body position) and physiologic changes as measured by pulse oximetry, heart rate and respiratory rate which occur in infants with congestive heart failure (CHF) secondary to congenital heart disease (CHD). This chapter presents demographic characteristics of the study sample, characteristics of the feeding behaviors, statistical analysis of the physiologic variables, case presentations of each child's feeding experience, and the similarities and differences in feeding behaviors of the study sample.

Demographic Characteristics of Study Sample

The sample consisted of nine hospitalized infants with various diagnoses of cardiac anomalies. All subjects met the inclusion criteria established prior to the study as outlined in Chapter III.

As shown in Table 1, the average age for the infants was 74.2 days with a range of five days to 180 days. Weight ranged from 3.18 kilograms (kg.) to 5.86 kg. with a mean of 4.26 kgs. The mean amount of time spent in feeding was 17.7 minutes with a range of 12-26 minutes.

Eight of the nine children were on some medication or combination of medications which contributed to the control of the CHF which was secondary to the cardiac anomaly. The infant who was not receiving medications was being challenged to determine whether medication was
Table 1. Selected Sample Characteristics

<table>
<thead>
<tr>
<th>Factor</th>
<th>Range</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>5-180 days</td>
<td>74.2 days</td>
</tr>
<tr>
<td>Weight</td>
<td>3.18-5.86 kgs.</td>
<td>4.26 kgs.</td>
</tr>
<tr>
<td>Time spent in feeding</td>
<td>12-26 minutes</td>
<td>17.7 minutes</td>
</tr>
</tbody>
</table>
required following a partial corrective surgery. The individual diagnoses of each child will be presented in the case studies.

**Characteristics of Feeding Behaviors**

The feeding behaviors observed during the feeding sessions of the infants were categorized according to caregiver activity and infant positions. This section describes the behavioral findings.

Table 2 summarizes the frequency of behaviors observed among the nurse-infant pair during the feeding episodes. The behaviors were computed from the data collection form and characterized according to caregiver activity and infant position. The behaviors are tallied by the number of infants who illustrated that behavior.

**Caregiver activity.** There were position changes experienced by the infants as a result of caregiver actions and include the semi-upright and upright positions. All of the infants experienced each of the positions (see Table 2). Each nurse was asked to place the infant in the semi-upright position upon picking the infant up for the feed. All of the infants remained in this position for various amounts of time during the feed. The semi-upright position can best be described as the standard feeding position. It is similar to the semi-Fowlers position where the body is at a 120 degree angle with the head in alignment with the body.

The upright position was also experienced by all of the children. This position was utilized by the caregivers to burp the infants during the course of the feeding. Generally speaking, the infants were placed on the nurse's lap in a sitting position although there were some
Table 2. Frequency of Behavior Observed Among Nine Infants During the Feeding Episodes

<table>
<thead>
<tr>
<th>Factor</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caregiver activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semi-upright</td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td>Upright</td>
<td>9</td>
<td>100%</td>
</tr>
<tr>
<td>Infant positions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left lateral head movements</td>
<td>7</td>
<td>78%</td>
</tr>
<tr>
<td>Right lateral head movements</td>
<td>2</td>
<td>22%</td>
</tr>
<tr>
<td>Arched back</td>
<td>1</td>
<td>11%</td>
</tr>
</tbody>
</table>
incidents where the nurses burped the infants by placing them over the shoulder. In this position, the body is at a 90 degree angle with the head slightly forward.

**Infant positions.** The postural behavior exhibited by the infants during the feeding was described as any self-mediated position change and includes left lateral head movements, right lateral head movements and arching of the back.

Left and right lateral head movements refer to the infant's effort to move the head away from the median line in relation to the bottle. Seven of the infants (78%) turned their heads to the left side of their bodies while 22% (two) turned their heads to the right. The specific amount of time spent in these lateral head movements varied among the infants.

The arched back movement was displayed by one child during the course of the feeding. This position can best be described as an extension of the standard feeding position where the child in question increased the angle of the body from 120 degrees to about 160 degrees.

**Statistical Analysis of the Physiologic Variables**

Measurements of heart rate (HR) in beats per minute (bpm), respiratory rate (RR) in inspirations per minute (ipm) and oxygen saturation (%SaO₂) were performed pre feed, during the feed, and post-feed on the nine infants. Table 3 depicts the pre feed range, median, mean, and standard deviation of the physiologic variables for the infants as a group.
Table 3. Range, Median, Mean and Standard Deviation of Pre Feed Physiologic Variables

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>105-163</td>
<td>141</td>
<td>139.2</td>
<td>15.78</td>
</tr>
<tr>
<td>RR</td>
<td>24-70</td>
<td>51</td>
<td>49.3</td>
<td>16.49</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>80-100</td>
<td>99</td>
<td>94.9</td>
<td>6.49</td>
</tr>
</tbody>
</table>
The pre feed readings were taken before the feeding was begun and are representative of a quiet, alert state in eight of the nine infants. One of the infants was crying. The mean HR was 139.2 bpm with a standard deviation of 15.78, the respiratory rate mean was 49.3 ipm with a standard deviation of 16.49 and the oxygen saturation mean was 94.9% with a standard deviation of 6.95.

During the feeding episode, the physiologic variables were measured every minute. Table 4 displays the range, median, mean and standard deviation per child of the heart rate, respiratory rate and the percent oxygen saturation. Discussions of the individual statistics are presented in the case presentations in the next section.

The mean SaO₂s of eight of the nine infants decreased from the pre feed value. The heart rate means during the feeding episodes decreased in six of the nine infants while the respiratory rate means decreased from the pre feed values in eight of the nine infants.

Table 5 displays the range, median, mean, and standard deviation of the physiologic variables during the feeding for the group of infants. The mean SaO₂ was 89% which is a decrease from the pre feed value. Heart rate mean for the group during the feeding episodes was 138 which is also a decrease from the pre feed value. Finally, the feeding respiratory rate mean for the group decreased from 49.3 pre feed to 42 inspirations per minute.

The post-feed values for the range, median, mean and standard deviation of the heart rate, respiratory rate and the oxygen saturation for each child are displayed in Table 6. These measurements were taken every minute for five minutes following the completion of the feed
Table 4. Range, Median, Mean and Standard Deviation for the Physiologic Variables During Feeding per Child

<table>
<thead>
<tr>
<th>Child</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Range</td>
<td>Median</td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Child 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>76–159</td>
<td>116</td>
<td>119.2</td>
<td>28.11</td>
</tr>
<tr>
<td>RR</td>
<td>18–60</td>
<td>40</td>
<td>39.5</td>
<td>12.81</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>73–94</td>
<td>81.5</td>
<td>83.3</td>
<td>6.59</td>
</tr>
<tr>
<td>Child 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>129–175</td>
<td>159</td>
<td>156.7</td>
<td>9.86</td>
</tr>
<tr>
<td>RR</td>
<td>29–58</td>
<td>49</td>
<td>48.2</td>
<td>10.61</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>74–100</td>
<td>96</td>
<td>92.8</td>
<td>7.82</td>
</tr>
<tr>
<td>Child 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>123–155</td>
<td>135.5</td>
<td>135.4</td>
<td>9.86</td>
</tr>
<tr>
<td>RR</td>
<td>18–52</td>
<td>34.5</td>
<td>34</td>
<td>10.61</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>80–100</td>
<td>96</td>
<td>92</td>
<td>7.82</td>
</tr>
<tr>
<td>Child 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>83–160</td>
<td>151</td>
<td>144.3</td>
<td>20.47</td>
</tr>
<tr>
<td>RR</td>
<td>16–71</td>
<td>37</td>
<td>40.3</td>
<td>16.12</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>77–93</td>
<td>88.5</td>
<td>86.1</td>
<td>5.16</td>
</tr>
<tr>
<td>Child 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>91–149</td>
<td>135</td>
<td>128.7</td>
<td>18.86</td>
</tr>
<tr>
<td>RR</td>
<td>18–65</td>
<td>34</td>
<td>36.8</td>
<td>12.75</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>88–100</td>
<td>89</td>
<td>88.9</td>
<td>6.51</td>
</tr>
<tr>
<td>Child 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>128–153</td>
<td>141.5</td>
<td>140.9</td>
<td>6.27</td>
</tr>
<tr>
<td>RR</td>
<td>18–63</td>
<td>40.5</td>
<td>41.7</td>
<td>13.93</td>
</tr>
<tr>
<td>%SaO$_2$</td>
<td>88–100</td>
<td>96</td>
<td>95.5</td>
<td>2.69</td>
</tr>
</tbody>
</table>
Table 4. Continued

<table>
<thead>
<tr>
<th>Child</th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child 7</td>
<td>73-184</td>
<td>130</td>
<td>136.5</td>
<td>40.21</td>
</tr>
<tr>
<td></td>
<td>RR</td>
<td>13-62</td>
<td>37</td>
<td>10.68</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>85-99</td>
<td>93</td>
<td>93.2</td>
<td>4.8</td>
</tr>
<tr>
<td></td>
<td>HR</td>
<td>81-166</td>
<td>149.5</td>
<td>139.1</td>
</tr>
<tr>
<td>Child 8</td>
<td></td>
<td></td>
<td></td>
<td>26.65</td>
</tr>
<tr>
<td></td>
<td>RR</td>
<td>19-83</td>
<td>34</td>
<td>18.44</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>85-99</td>
<td>91.5</td>
<td>91.4</td>
<td>4.19</td>
</tr>
<tr>
<td></td>
<td>HR</td>
<td>94-145</td>
<td>125.5</td>
<td>125.1</td>
</tr>
<tr>
<td>Child 9</td>
<td></td>
<td></td>
<td></td>
<td>15.52</td>
</tr>
<tr>
<td></td>
<td>RR</td>
<td>29-90</td>
<td>47</td>
<td>15.91</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>68-85</td>
<td>74.5</td>
<td>75.3</td>
<td>5.89</td>
</tr>
</tbody>
</table>
Table 5. Range, Median, Mean and Standard Deviation for the Physiologic Variables During Feeding for the Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>73-184</td>
<td>142</td>
<td>138</td>
<td>24.27</td>
</tr>
<tr>
<td>RR</td>
<td>13-90</td>
<td>40</td>
<td>42</td>
<td>13.78</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>68-100</td>
<td>91</td>
<td>89</td>
<td>8.13</td>
</tr>
</tbody>
</table>
Table 6. Range, Median, Mean and Standard Deviation For the Post-feed Physiologic Variables Per Child

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>126-155</td>
<td>130.5</td>
<td>136.8</td>
<td>13.50</td>
</tr>
<tr>
<td>RR</td>
<td>32-67</td>
<td>57.5</td>
<td>51.8</td>
<td>15.20</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>94-99</td>
<td>97</td>
<td>96.5</td>
<td>1.64</td>
</tr>
<tr>
<td>Child 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>140-166</td>
<td>156.5</td>
<td>155.2</td>
<td>8.77</td>
</tr>
<tr>
<td>RR</td>
<td>21-57</td>
<td>34</td>
<td>36</td>
<td>12.93</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>94-100</td>
<td>98</td>
<td>97.5</td>
<td>2.26</td>
</tr>
<tr>
<td>Child 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>84-148</td>
<td>118.5</td>
<td>119.7</td>
<td>22.19</td>
</tr>
<tr>
<td>RR</td>
<td>19-76</td>
<td>34</td>
<td>37.5</td>
<td>20.90</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>78-97</td>
<td>93</td>
<td>89.3</td>
<td>9.16</td>
</tr>
<tr>
<td>Child 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>137-146</td>
<td>139.5</td>
<td>139.8</td>
<td>3.19</td>
</tr>
<tr>
<td>RR</td>
<td>31-81</td>
<td>77</td>
<td>69</td>
<td>19.07</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>89-97</td>
<td>96</td>
<td>94.8</td>
<td>3.13</td>
</tr>
<tr>
<td>Child 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>109-148</td>
<td>141.5</td>
<td>135</td>
<td>14.80</td>
</tr>
<tr>
<td>RR</td>
<td>28-57</td>
<td>33.5</td>
<td>36.8</td>
<td>11.20</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>90-98</td>
<td>94.5</td>
<td>94.7</td>
<td>3.20</td>
</tr>
<tr>
<td>Child 6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>119-138</td>
<td>132.3</td>
<td>131.5</td>
<td>6.66</td>
</tr>
<tr>
<td>RR</td>
<td>15-48</td>
<td>26</td>
<td>28.5</td>
<td>13.38</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>94-98</td>
<td>96.5</td>
<td>96.7</td>
<td>1.75</td>
</tr>
</tbody>
</table>
Table 6. Continued

<table>
<thead>
<tr>
<th></th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>115–150</td>
<td>129</td>
<td>130.2</td>
<td>14.24</td>
</tr>
<tr>
<td>RR</td>
<td>24–53</td>
<td>38.5</td>
<td>40</td>
<td>10.20</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>94–98</td>
<td>96</td>
<td>96.4</td>
<td>1.67</td>
</tr>
<tr>
<td>Child 8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>147–161</td>
<td>154.5</td>
<td>154.2</td>
<td>6.80</td>
</tr>
<tr>
<td>RR</td>
<td>25–88</td>
<td>73.5</td>
<td>65</td>
<td>27.53</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>93–96</td>
<td>95</td>
<td>94.8</td>
<td>1.26</td>
</tr>
<tr>
<td>Child 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR</td>
<td>101–124</td>
<td>117</td>
<td>115</td>
<td>8.10</td>
</tr>
<tr>
<td>RR</td>
<td>23–67</td>
<td>42.3</td>
<td>44</td>
<td>14.08</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>74–81</td>
<td>76.5</td>
<td>77.3</td>
<td>2.66</td>
</tr>
</tbody>
</table>
and while the child was in a safe position such as semi-upright, prone, or side lying. The post feed mean values for the oxygen saturation approached or exceeded the pre feed value in seven infants and the feeding value in eight. Heart rate post-feed mean values decreased from the pre feed and feeding values in six of the nine infants. Finally, the respiratory rate means decreased from the pre feed values in six infants and in four infants, the means were lower from the feeding values.

Table 7 displays the post-feed range, median, mean and standard deviation of the physiologic variables for the group. When compared to the pre feed values for the group, all of the post-feed values represent a decrease. However, the post-feed respiratory rate and oxygen saturation increased from the feeding values while the heart rate continued to decrease from the feeding value. This decrease of the HR can be attributed to the parasympathetic response which occurs during and after ingestion of food.

**Case Presentations**

This section presents a discussion of each of the nine infants. Along with the discussions are graphs which depict each child's feeding experience.

**Child One.** The first subject was an eight week old female who had undergone a repair for a coarctation of the aorta at six weeks of age and had a remaining ventricular septal defect. At the time of the study, she was not on any medications because she was being challenged. Her pre feed SaO₂ was 100%; HR 163; and RR 44. This child
Table 7. Post-feed Range, Median, Mean and Standard Deviation For the Physiologic Variables For the Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Range</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>115-115.2</td>
<td>135</td>
<td>135.27</td>
<td>13.56</td>
</tr>
<tr>
<td>RR</td>
<td>28.5-69</td>
<td>40</td>
<td>45.4</td>
<td>13.8</td>
</tr>
<tr>
<td>%SaO₂</td>
<td>77.3-97.5</td>
<td>94.8</td>
<td>93.11</td>
<td>6.39</td>
</tr>
</tbody>
</table>
was supine and quiet at the time of the measurements. Figure 2 depicts her feeding experience and shows a decrease in all of the physiologic variables at the onset of the feed. This child spent 18 minutes engaged in the feeding process with a total of 12 position changes. Ten minutes (55.6%) of the total feeding time were spent in positions due to caregiver activity while 44.7% of the time (eight minutes) reflects self-mediated positioning. The mean value (see Table 4) for the physiologic variables measured during the feeding were: SaO₂—83.3; HR—119.2; and RR—39.5; all of which are a decrease from the pre feed values. Upon completion of the feed, this child was placed in the crib and in the right lateral position. The post-feed mean values (see Table 6) for this child reflect a decrease in the SaO₂ and HR from the pre feed with an increase in the respiratory rate. The post-feed mean values for all of the variables increased from the feeding values.

Child Two. The second child was newly diagnosed with a ventricular septal defect and was in active CHF at the time of the observation. This five week old male was being medicated with Digoxin and Lasix. The pre feed values were taken while the child was supine and in an alert attending state. They were SaO₂—100%; HR—141; and RR—64. A total of 26 minutes was spent in the task of eating and is displayed in Figure 3. At the onset of the feeding process, the SaO₂ and RR decreased while the heart rate increased. This child underwent 14 position changes throughout the feed. Caregiver activity accounts for position changes during 19 minutes (73%) of the total feeding time while self-mediated position changes occurred during 27% (seven minutes) of the feed. There were frequent pauses in the feeding which were
Figure 2. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject One.
Figure 3. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Two.
spent in stimulation of this baby who frequently fell asleep during the feeding. Mean feeding values (see Table 4) of \( \text{SaO}_2 \) and RR decreased from the pre feed values while heart rate increased. Toward the end of the feed, the \( \text{SaO}_2 \) decreased to 74%. At the end of the feed, this child was placed in the prone position in the crib and remained quiet with his eyes closed throughout the post-feed observation period. The mean post-feed values of \( \text{SaO}_2 \)—97.5%; HR—155.2; and RR—36 represent a decrease in oxygen saturation and respiratory rate and an increase in the heart rate from the pre feed values. The post-feed values for HR and RR decreased and \( \text{SaO}_2 \) increased from the feeding value.

Child Three. This six month old male had presented in the emergency room with severe CHF and was diagnosed with a cardiac anomaly of unspecified origin. At the time of the study, he was being treated with Digoxin, Lasix and Captopril. The pre feed values of HR—136; RR—45; and \( \text{SaO}_2 \)—89 were obtained while this baby was in a supine position and, despite all efforts, fussy and crying. At the onset of the feed, he eagerly approached the task of eating but soon became very playful and easily distracted by his surroundings and nurse. As can be seen in Figure 4, the \( \text{SaO}_2 \) and HR increased from the pre feed value while the RR decreased at the onset of the feed. Twelve minutes were spent in the feeding process with seven position changes. All of the position changes were due to caregiver activity. This child did not initiate any position changes at any time throughout the feed. During the feed itself, the mean values for \( \text{SaO}_2 \), HR and RR (see Table 4) show an increase in oxygen saturation, a decrease in respiratory rate, and no appreciable change in the heart rate from the pre feed
Figure 4. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Three.
values. The prone position was chosen by the nurse upon completion of the feed and this child's activity level ranged from quiet to alert, attending with a short period of fussiness at the end of the post-feed observation period. The mean post-feed values (see Table 6) of the physiologic variables represent a decrease in the HR and RR and no changes in the oxygen saturation from the pre feed values. Post-feed values for HR and SaO₂ decreased from the feeding values while the respiratory rate increased.

Child Four. The fourth subject observed during this study was a five day old female with a preliminary diagnosis of complex CHD. A differential diagnosis was not available but CHF was noted to be present. The medications which were being administered to this child were Digoxin and Lasix. Figure 5 depicts the feeding experience for this infant and shows pre feed values of 92% for the SaO₂, 135 for the HR, and a RR of 61. These values were obtained while she was in a supine position and a quiet state. This child had a poor feeding history due to her inability to remain awake during the feed. At the onset of the feed, the oxygen saturation and respiratory rate decreased while the heart rate increased slightly. A total of 16 minutes was spent by this child as she attempted to eat and she underwent six position changes. There was one self-mediated position change which accounts for 6.25% of the total feeding time while the remaining five changes (93.75%) can be attributed to caregiver activities. The mean values measured during the feed (see Table 4) for this child show a decrease in SaO₂ and RR and an increase in the HR from her pre feed values. This child's nurse paused several times during the feed in
Figure 5. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Four.
order to stimulate this infant to eat. This subject fell asleep towards the end of the feed and remained that way throughout the post-feed observation period while she was in the prone position. Table 6 displays the post-feed means of $\text{SaO}_2$, HR, and RR and shows an increase in all of the physiologic variables from the pre feed state. When compared to the feeding values, the post-feed RR and $\text{SaO}_2$ increased and the HR decreased.

Child Five. This four month old female with a coarctation of the aorta, ventricular septal defect, CHF, and failure to thrive was the fifth subject of this study. She was treated with Digoxin, Lasix and Aldactone in an effort to control the CHF. Because she had developed an aversion to eating, her hospitalization was a lengthy one. The amount of time that she was permitted to nipple was limited and any portion of her feed that was not nippled was given per nasogastric tube. The pre feed values were obtained while she was supine and in an alert, attending state. These values, shown in Figure 6, were 100% for the $\text{SaO}_2$, 150 for the HR, and 60 for the RR. This infant engaged in feeding for 14 minutes and had eight position changes. In addition, she was very irritable and restless during the feed and exhibited several position changes between the one minute intervals. Ten minutes (71.4%) of the feeding time were spent in positions due to caregiver activities while the remainder of the total feeding time (28.6%) was spent in self-mediated position changes. All of the physiologic variables decreased at the onset of the feed. The mean measurements taken during the feed (see Table 4) show a decrease in the oxygen saturation, heart rate and respiratory rate from the pre feed values. Similarly,
Figure 6. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-feed for Subject Five.
Table 6 shows a decrease in the post-feed mean measurements when compared to the pre feed values. This child fell asleep in the semi-upright position in the nurse's arms and remained in that position for the entire post-feed observation period. Post-feed values of HR and \( \text{SaO}_2 \) increased from the feeding values while there was no change in the respiratory rate.

**Child Six.** The sixth infant who was observed during this study was an 11 day old male who had undergone a Jatene procedure to correct Transposition of the Great Arteries. This child was eight days post operative and although this child had corrective surgery, an echocardiography report done prior to discharge showed significant damage to the heart — particularly the left ventricle. Digoxin was administered to this child. While in a supine position and quiet state, the pre feed measurements of \( \text{SaO}_2 \)=100%; HR=148; and RR=25 were obtained. This child took a total of 22 minutes to eat and experienced eight position changes. Figure 7 displays the feeding experience for this child. Twenty-one minutes (95.4%) of the feeding time were spent in positions due to caregiver activities. About one-half of the feeding time was devoted by the nurse towards stimulation of this baby who frequently fell asleep. Self-mediated position changes accounted for 4.5% of the total feeding time. The oxygen saturation and heart decreased at the onset of the feed while RR increased. This same pattern was reflected in the mean values for \( \text{SaO}_2 \), HR and RR throughout the feed itself and in the post-feed period (see Tables 4 and 5). The post-feed position chosen by the nurse was the prone position and this infant proceeded from a quiet to sleeping state. When compared to
Figure 7. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Six.
the feeding mean values, the post-feed HR and RR decreased and the oxygen saturation increased.

**Child Seven.** This four month old female had been diagnosed with a cardiomyopathy which involved left ventricular hypertrophy, dilated ventricles, and CHF with severe diaphoresis. She was medicated with Digoxin and Lasix. Figure 8 depicts the feeding experience for this child. The pre feed data of 99% for the SaO₂, HR of 134, and RR of 24 was obtained while the infant was sleeping in the prone position. Throughout the feed of 19 minutes, this infant remained very attentive to her nurse, displayed good eye contact, and maintained a strong suck. There were seven position changes. Nine minutes (47.4%) of the feed were spent in positions due to caregiver activity while ten minutes (52.6%) accounted for self-mediated position changes. At the onset of the feed, the SaO₂ and HR decreased while the respiratory rate increased. The mean values for the physiologic parameters (see Table 4) measured during the feed itself show a decrease in the SaO₂ and an increase in the HR and RR from the pre feed values. Approximately halfway through the feed, this infant was extremely diaphoretic and there was a decrease in the SaO₂. Upon completion of the feed, this child's nurse chose to hold her in the semi-upright position and she was quiet for the duration of the post-feed observation period. The mean values for the post-feed physiologic variables (see Table 6) reflect a decrease in the oxygen saturation and heart rate while the respiratory rate increased from the pre feed values. When compared to the feeding mean values, there was a decrease in HR, an increase in SaO₂, and no change in the respiratory rate for the post-feed values.
Figure 8. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Seven.
The pulse oximeter sensor lost contact with this child's skin at the beginning of the post-feed period due to the diaphoresis and resulted in missing data.

**Child Eight.** The eighth child chosen for this study was a three week old male. Two days after birth, this child had undergone a partial repair for total anomalous pulmonary venous return. Despite the surgery, this child remained in CHF and required medication with Digoxin and Ethacrynic Acid. While in the supine position and quietly sucking on his pacifier, the pre feed data of $\text{SaO}_2=94\%$; $\text{HR}=141$; and $\text{RR}=51$ was obtained. Figure 9 is a display of the feeding experience and shows a duration of 16 minutes with 11 position changes. There were four position changes which occurred between the one minute intervals. Positions due to caregiver activity account for 14 minutes (87.5%) of the feed while the remaining two minutes (12.5%) of the feed were spent in self-mediated positions. The initial data obtained at the onset of the feed shows a decrease in all of the physiologic parameters measured when compared to the pre feed data. Table 4, which displays the mean values for $\text{SaO}_2$, HR and RR during the feed, shows a similar decrease in the oxygen saturation, heart rate and respiratory rate from the pre feed data. Halfway through the feed, this infant fell asleep and experienced a 10 point increase in the $\text{SaO}_2$. At the conclusion of the feed, this infant was placed in his crib in the right lateral position and became very fussy and cried for two minutes. As a result, neither the pulse oximeter nor the cardiorespiratory monitor recorded data during this time period. The infant was placed in the prone position and offered his pacifier — he eventually fell
Figure 9. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-Feed for Subject Eight.
asleep. The post-feed mean data (see Table 6) for this infant shows an increase in the HR and RR from the pre feed values while the oxygen saturation approximated the pre feed value. This child was very eager to feed at the onset of the feed but displayed cyanosis at times and attempted to fall asleep several times. The post-feed means for all of the physiologic variables increased from the feeding values.

Child Nine. This four month old male had been hospitalized for a cardiac catheterization which showed the need for imminent corrective surgery for Transposition of the Great Arteries, ventricular septal defect and CHF. At the time of the study, he was medicated with Digoxin and Lasix. This child was awake, alert, and attending and in the supine position when the pre feed values of SaO₂—80%; HR—105; and RR—70 were obtained. Figure 10 displays the feeding experience for this child. The feeding process took 15 minutes during which there were 10 position changes. When this baby began to feed, there was a small decrease in SaO₂ and RR while the HR increased. During the feed, this infant did not maintain eye contact with the nurse but looked straight ahead. Six minutes (40%) of the feed were spent in positions due to caregiver activities while the remaining 60% (nine minutes) were self-mediated position changes. The mean values for the feeding physiologic variables (see Table 4) show an increase in the heart rate and a decrease in the SaO₂ and RR from the pre feed data. This pattern was maintained in the post-feed period (see Table 6). The infant was placed in the supine position at the end of the feeding but was quickly repositioned into the right lateral position and became alert and attending. As Figure 10 shows, data is missing from the 13th minute
Figure 10. Physiologic Variables and Position Changes: Pre Feed, Feeding and Post-feed for Subject Nine.
of the feeding due to a temporary disconnection of both of the monitors. When compared to the feeding mean values, the post-feed HR and RR decreased while the oxygen saturation increased.

Relationship Among Study Variables

The position changes of the infants, as seen in the preceding case presentations, had variations in the physiologic responses. The positions which the infants assumed or which the caregivers placed them into were categorized and described earlier in this chapter.

Correlation coefficients were computed to see if a relationship could be described between the position changes and the physiologic variables. The relationships were calculated by point biserial correlation coefficients utilizing time as the unit of analysis. Although only nine infants were observed in this study, 158 observations of positions were made during the feeding episodes. Table 8 displays the point biserial correlation coefficients and the levels of significance.

The investigator was primarily interested in the relationship between the positions and the oxygen saturation. However, there were some significant correlations involving the heart rate and respiratory rate.

The upright position, used by the caregivers for the burping process, correlated negatively ($r = -.2621, p < .001$) with the oxygen saturation and heart rate ($r = -.1305, p < .05$). This position correlated positively with the respiratory rate ($r = .1367, p < .05$).
Table 8. Point Biserial Correlation Coefficients For Feeding Positions and Physiologic Variables

<table>
<thead>
<tr>
<th>Position</th>
<th>HR</th>
<th>RR</th>
<th>%SaO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upright</td>
<td>-.1305*</td>
<td>.1367*</td>
<td>-.2621***</td>
</tr>
<tr>
<td>Semi-upright</td>
<td>.2168**</td>
<td>-.0043</td>
<td>.3944***</td>
</tr>
<tr>
<td>Left lateral head movements</td>
<td>-.0447</td>
<td>-.0450</td>
<td>-.1699*</td>
</tr>
<tr>
<td>Right lateral head movements</td>
<td>-.1737*</td>
<td>-.1382*</td>
<td>-.1082</td>
</tr>
<tr>
<td>Arched back</td>
<td>-.0912</td>
<td>-.0458</td>
<td>-.0911</td>
</tr>
</tbody>
</table>

*** p < .001  
** p < .01  
* p < .05
The semi-upright position or the standard feeding position and the oxygen saturation correlated positively ($r = .3944$, $p \leq .001$). A similar positive correlation occurred between the semi-upright position and the heart rate ($r = .2168$, $p \leq .01$). No significant correlation existed between the respiratory rate and this position.

The only physiologic variable which correlated with left lateral head movements was the oxygen saturation ($r = -.1699$, $p \leq .05$), in the negative direction.

Right lateral head movements were negatively correlated with heart rate ($r = -.1737$, $p \leq .05$) and the respiratory rate ($r = -.1382$, $p \leq .05$). There was no significant correlation between oxygen saturation and this position.

The arched back position, which was assumed by only one child and at only one time, was not significantly correlated with any of the physiologic parameters.

**Similarities and Differences in Behaviors and Physiologic Parameters**

Similarities and differences in behaviors exhibited during the feedings by the infants and changes in measured physiologic parameters were identified by reviewing the feeding experiences of these children. The similarities and differences which were identified were quantitative in nature.

All of the children experienced position changes which were due to caregiver activities. The changes were necessary and part of the usual feeding practice -- an example is the change of position which accompanies the burping process. Eight of the nine children
initiated self-mediated position changes which varied between left or right lateral head movements and arching of the back. The position changes which were noted at the one minute intervals were accompanied by changes in the previously recorded physiologic variables. The physiologic parameters increased or decreased among the position changes and from child to child with the same position change. Desaturation occurred in eight of the nine infants at the onset of the feeding. Finally, the change of position which was experienced by the children during the burping process (semi-upright to upright) was accompanied by desaturation.

The differences which existed among the nine children during the feeding process are of particular interest. The amount of time which was spent in the feed itself varied from 12-26 minutes. The graphs which display the feeding process of each child (see Figures 2-10) show a difference in the degree of change in the physiologic variables when the position changed. The amount of time which each child spent in self-mediated position changes varied from 4.5% to 60% of the total feeding time. Four of the nine children fell asleep during the feed which necessitated some additional position changes in order to stimulate the infants and continue the feeding process. Observations were made of self-mediated positioning which occurred between the one minute intervals in four of the nine infants.

Summary

This chapter presented the data and observations which were made during the feeding episodes of nine children with CHF secondary
to CHD. Demographic data, characteristics of feeding behaviors, statistical analysis of the measured physiologic variables, and case presentations were included. Awareness of the feeding behaviors and changes in saturation, heart rate, and respiratory rate may contribute to a better understanding of the feeding experiences of this group of children.
CHAPTER V
DISCUSSION OF THE RESULTS

This chapter relates the findings to the conceptual framework and the research questions and discusses the physiologic considerations of the data. In addition, applications to nursing practice and recommendations for further research are suggested.

Findings Related to the Conceptual Framework

The feeding episodes of children with congestive heart failure (CHF) secondary to congenital heart disease (CHD) were observed and categorized as stressful experiences based on changes in oxygen saturation from a pre feed state to a feeding state. Nipple feeding is not a passive exercise — it involves an expenditure of energy. The mean values for all of the physiologic variables measured during the feeding process decreased from the pre feed values. Various changes associated with feeding have been cited in the literature and include bradycardia, apnea, hypoxemia, drops in transcutaneous oxygen levels, and deceleration of the heart (Mathew et al., 1985; Guilleminault & Coons, 1984; Shivpuri et al., 1983; Winter et al., 1966).

Although the prone position was found to be the optimal position for nursing care delivery in the research literature, this position is not conducive to the nipple feeding process (Wagaman et al., 1979; Schwartz et al., 1975). The present study was undertaken to formally identify positioning which occurs during the feeding process. These
positions were categorized and described in the previous chapter. The present study documented the existence of self-mediated position changes among children with CHF secondary to CHD during feeding. A limitation of the study was the inability to control the actions of the caregivers. The nurses feeding the infants did not allow the babies total freedom to remain in any of the self-mediated positions. This interference was unintentional as all the nurses expressed an understanding of the instructions which were given to them prior to the observations. It is possible that more position changes could have been observed in the absence of this limiting factor. The semi-upright position, when assumed and regardless of the previous position, was accompanied by an increase in the oxygen saturation. It is known that the work of breathing can be reduced by placing the body in the semi-Fowler position (Rudolph & Hoffman, 1982).

The physiologic variables which were measured changed throughout the feedings and varied when compared with the position changes for each child and for the group as a whole. Oxygen saturation was of particular interest since oxygen supply is maintained by increased alveolar ventilation or increased cardiac output with a precise integration of cardiovascular and respiratory functions (Vander, 1975). Although changes in position were accompanied by physiologic changes, neither a causal relationship nor a statement regarding the adaptive or maladaptive nature of the changes can be assumed.
Findings Related to the Research Questions

This study was undertaken to answer the following research questions: 1) what feeding behaviors, as defined by changes in body position, are exhibited to children with CHF secondary to CHD?; and 2) what, if any, are the short term physiologic changes associated with the behaviors as measured by pulse oximetry, heart rate, and respiratory rate?

The observations of these children show that position changes due to caregiver activities are a natural part of the feeding process. Self-mediated position changes do occur while the infants are nipple feeding. The reasons behind the position changes are unclear at this time. The results of this study do not indicate whether the efforts of these children to change position are adaptive or maladaptive.

The physiologic variables which were measured during the feeding process indicate some changes to various degrees at the time of the position change. However, the available data does not lend itself to a causal relationship between physiologic parameters and position changes. In other words, observed position changes were accompanied by recorded changes in heart rate, respiratory rate, and oxygen saturation, but whether there is a causal relationship cannot be determined using this data set.

Physiologic Considerations of the Data

There were some statistically significant relationships found among some of the positions and the physiologic measurements. Whether changes in physiologic variables were causally related to position
changes were unable to be determined. However, those that exist will be discussed in this section.

The upright position resulted in the infant sitting in the nurse's lap in a 90 degree angle with the head slightly forward and the diaphragm compressed against the stomach contents. The oxygen saturation was also negatively correlated with this position. One possible explanation is that this position results in the ability of the infant to fully expand the diaphragm with less oxygen being readily available. Therefore, the respiratory rate might increase to try to compensate for this deficit.

Oxygen saturation and heart rate were significantly positively correlated with the semi-upright position. This position is very similar to the semi-Fowler position. In this orthopneic position, the liver impinges minimally on the diaphragm, venous return to the heart and lungs is diminished, and pulmonary congestion may be relieved (Scipien, Barnard, Chard, Howe & Phillips, 1986). One can imagine how much easier the work of breathing becomes resulting in the increased oxygen saturation.

Left lateral head movement describes a position where the infant turns the head away from the median line. This position was also significantly negatively correlated with the oxygen saturation. Spoelstra and Srikasibhandha (1973) found that it is precisely the position of the head in relation to the body that affects the lung mechanics. In their study, the ventilation/perfusion loops decreased when the head was not in the median line and resulted in inhibition of lung mechanics. This might explain the decrease in the oxygen
saturation. It can be speculated that the infants in the present study turned their heads away from the bottle in an effort to escape from some of the stress of feeding.

Finally, the right lateral head position correlated negatively with heart rate and respiratory rate. Since the majority of the infants were held in the nurse's left arm, assumption of this position would be more difficult. However, some of the infants were placed in the nurse's right arm which would allow them to turn their heads to the right. Again, the infants may have turned their heads away from the bottle to provide a break from the stress of feeding. The reduction in heart rate and respiratory rate could have been a response to the temporary removal of the stress. This positioning of the head may also have resulted in some compression of the carotid artery which resulted in a vagal response.

The arched back position, which did not significantly correlate with any of the physiologic variables, has been documented in the literature (Gillon, 1973). The lack of correlation might be due to the limited number of observations of this position or to the inability of the infants to assume this position due to caregiver interference.

As stated earlier, the positions which were observed during the feeding episodes were generally of short duration due to the unintentional interference of the caregivers. The positions due to caregiver activities or nurse-mediated positions seemed to revolve around the completion of the task of feeding. The infant-mediated positions appear to be an effort to break away from the stress associated with the feed. Although statistically significant relationships
between positions and physiologic variables were found, the results of this study do not necessarily provide guidance for pediatric nurses regarding the feeding of these infants.

Methodological Difficulties

This study was a naturalistic observation of a structured event. Prior to each observation, the nurses responsible for the feeds were instructed regarding their responsibilities during the feed. Once the observation began, it would have been a break in protocol to provide further instructions. The investigators noted behaviors of the nurses which were not congruent with the given directives. One such example is the behavior of the nurses which corrected infant-mediated positioning or limited the amount of time that the infants were permitted to remain in these positions. This is not attributed to a lack of understanding of the given directives but rather a product of habituation to the task of feeding infants. It is much easier to hold an infant in the semi-upright position during a feed. This behavior may also contribute to a nurse's meeting her own needs: cuddling an infant during a feed is considered proper behavior. It may be proposed that the cuddling of an infant that contributes to its security during a feed could contribute to a positive feeling in the caregiver.

Applications to Nursing Practice

The method of study used for this investigation has implications for nursing. The concept of naturalistic observation is not new to nursing but the use of this recording format for infant behaviors
while feeding can be employed for use by nurses in learning about and giving assistance to parents in understanding the child's behavior.

The nurse needs to fully assess the cues which the infant might be sending to the caregiver. Recognition of the infant's contribution to the feeding is critical. Although this group of children may present a challenge in feeding, this process may be accomplished much easier if the caregiver allows the child some control. Too often, nurses are only concerned with the caloric intake and the completion of the task of feeding. The use of naturalistic observation can help the nurse become aware of the feeding experiences of a group of children for whom feeding is a stressful experience.

The use of cardiorespiratory monitors throughout the feed may also help nurses to better understand the effects of feeding on this group of infants. For instance, the infant who experiences bradycardia during the feed, as documented by the monitor, may need more rest periods than some other infants. Awareness of the child's physiologic parameters may help nurses to provide the necessary calories to the infant without further compromising the infants already stressed physiologic state. Increasing weight gain may help to prepare the infants for earlier surgical intervention.

Finally, any information gained from this study can be used as a part of the discharge teaching for parents. The nurse can help the parents to understand the subtle cues which the infant is demonstrating. This may contribute to better parental understanding of the best method to provide the feeding in the least stressful manner.
Recommendations For Future Research

This study attempted to integrate the concepts of stress during feeding, adaptation through positioning, and changes in physiologic variables. Findings are limited by the study's descriptive nature, the small sample size, accuracy of the measurement instruments, and the unintentional interference of the caregivers.

Recommendations for future research arising from this study are:

1) This study be replicated with a larger sample. A small convenience sample limits the generalizability of the study and the influence of the information obtained. Findings were not consistent and a larger sample might provide more conclusive results.

2) The subjects in this study had one common denominator: all were subject to CHF. Another study which utilizes a more homogenous group might produce results that are more consistent. An effort should be made to use infants with cardiac anomalies in which the lesions/CHD share common physiologic characteristics such as cyanosis or altered pulmonary vascularity.

3) The method of observation should be augmented through the use of videotape monitoring. Much of the behavior of the infants might have been missed because of the one minute measurement intervals.
4) The use of pulse oximetry provides a measurement of oxygen saturation. Use of transcutaneous oxygen measurements might produce more accurate results since transcutaneous oxygen measurement is more indicative of ventilatory status.

5) All of the nurses expressed an understanding of their participation and expectations while feeding the infants. Only one of the nine nurses allowed the infant to position itself during the feed without attempting to correct that positioning. Another study which utilizes only one caregiver who has been trained to feed the infants might produce more consistent results.

6) A study comparing the behaviors of infants who are fed by the nurses and those fed by their mothers. This study only utilized nurses and mothers may be more aware of the subtle cues which are demonstrated by their own infants.

Summary

This chapter presented a discussion of the findings as they relate to the conceptual framework and the research questions. The physiologic considerations of the data were also discussed. Recommendations for future research and applications to nursing practice were offered.

The study results show that position changes do occur during the feeding of infants with CHF secondary to CHD. These position changes are also accompanied by changes in measured physiologic
variables. The results are not indicative of a causal relationship between position changes and physiologic variables. However, there are some statistically significant relationships between some of the positions and certain physiologic variables.
APPENDIX A

HUMAN SUBJECTS APPROVAL
6 November 1987

Mary Lou Korpon, R.N.
4500 East Sunrise Apt. S6
Tucson, AZ 85718

Dear Ms. Korpon:

We have received the revised consent form for your project, "Behaviors and Physiological Consequences During Feeding of Infants With Congestive Heart Failure Secondary to Congenital Heart Disease". The procedures to be followed in this study pose no more than minimal risk to participating subjects. Regulations issued by the U.S. Department of Health and Human Services [45 CFR Part 46.110(b)] authorize approval of this type project through the expedited review procedures, with the condition(s) that subjects' anonymity be maintained. Although full Committee review is not required, a brief summary of the project procedures is submitted to the Committee for their endorsement and/or comment, if any, after administrative approval is granted. This project is approved effective 6 November 1987.

Approval is granted with the understanding that no changes or additions will be made either to the procedures followed or to the consent form(s) used (copies of which we have on file) without the knowledge and approval of the Human Subjects Committee and your College or Departmental Review Committee. Any research-related physical or psychological harm to any subject must also be reported to each committee.

A university policy requires that all signed subject consent forms be kept in a permanent file in an area designated for that purpose by the Department Head or comparable authority. This will assure their accessibility in the event that university officials require the information and the principal investigator is unavailable for some reason.

Sincerely yours,

Milan Novak, M.D., Ph.D.
Chairman
Human Subjects Committee

MN/ms

cc: Departmental/College Review Committee
TO: Dr. William Speck & Leslie Clark
Department Chairman

The University Hospitals Institutional Review Board has reviewed the proposal submitted by Mary Lou Korpon RN, Sally Lambert PhD RN
Entitled: Behaviors and physiological consequences during feeding of infants with congestive heart failure secondary to congenital heart disease (01-88-10)

Please be advised that with respect to:

1. The rights and welfare of the individuals.
2. The appropriateness of the methods to be used to secure informed consent.
3. The risks and potential medical benefits of the investigation, the Board considers this project

FULLY ACCEPTABLE, WITHOUT RESERVATION

NOT ACCEPTABLE FOR REASONS NOTED

REMARKS:
SEND COMMUNICATIONS TO: Dr. Sally Lambert
Pediatrics

1/19/88
Date of Approval

FOR ORA USE:
Type Project

NEW

Renewal

Addendum

Human Risk

Yes

No

SOURCE OF SUPPORT:
Departmental

Outside Funding

Agency(Potential)

Agency Number

Are any of the following involved?

Minors

Fetuses

Abortuses

Prisoners

Pregnant

Mentally Retarded

Mentally Disabled

No

Yes, those checked

CC: Investigator, ORA

This IRB operates under the following general assurances and identification numbers:

CWRU M1258 ID 02
UH M1398 ID 01
APPENDIX B

PARENTAL AND NURSING CONSENT FORMS
UNIVERSITY HOSPITALS OF CLEVELAND
PATIENT CONSENT FOR INVESTIGATIONAL STUDIES

TITLE OF PROJECT: Behaviors and Physiological
Consequences During Feeding of Infants With
Congestive Heart Failure Secondary to Congenital Heart Disease

DESCRIPTION OF STUDIES:

I understand that I am being asked to give my permission for my baby to participate in
a study conducted by Ms. Korpon. She has informed me that the purposes of her study are to
describe (1) the feeding behaviors of infants who have congestive heart failure because of
a heart defect; and (2) the physiological consequences of these behaviors as measured by
heart rate, breathing rate, and oxygen level in the blood.

I am aware that my baby will be observed by two observers as he/she is being fed by the
nurses and that his/her heart rate and oxygen level will be measured by a device which is
attached to my baby's big toe. I understand that this device will not cause my baby any pain
and that my baby's breathing rate will be measured by a stethoscope. I understand that
these observations will be done before, during, and after one regularly scheduled feeding
and will take place in my baby's room in the hospital.

I understand that the information gained from this study will be written in a thesis and
be made available to other health professionals. This information may help nurses to feed
babies with heart problems more efficiently. I understand that I may ask questions about this
study at any time and that I may withdraw my baby from the study at any time. My decision
to allow my baby to participate or not to participate in this study will not affect his/her
medical care. My child's physician has given permission for my baby to participate in this
study.

I understand that participation in this study is strictly voluntary and involves no cost
to me at any time. I also understand that I will not be paid for my participation. I am
aware that my name or my baby's name will not be used and all data collected will be kept
in a locked file.

Mary Lou Korpon has described to me what is going to be done,
how it is going to be done, the risks, hazards and benefits involved, and will be available
for questions at 844-1960. I understand that my decision to participate
or not to participate in this study will not alter my usual health care. In the use of
information generated from this study, my identity will remain anonymous. I am aware that
I may withdraw from this study at any time. I further understand that in the event of
physical injury or illness occurring to me resulting from the research procedures, University
Hospitals will not provide free medical care or compensation for lost wages. Further
information with respect to this topic is available from the Office of the Chief of Staff.
I understand that by signing this consent form, I do not waive any of my legal rights nor
does it relieve investigators or suppliers of liability, but merely indicates that I have
been informed about the research study in which I am agreeing to participate. A copy of
this form is available to me upon request.

Signature __________________________ Age ______ Date __________
Parent or Guardian Signature __________________________ (If subject is a minor)
Witnessed by __________________________ Date __________

JMB (Signature of Project Investigator) Date __________

(9/85)
DESCRIPTION OF STUDIES:

I understand that I am being asked to participate in a study conducted by Ms. Korpon. She has informed me that the purposes of her study are to describe (1) the feeding behaviors of infants who have congestive heart failure because of a heart defect; and (2) the physiological consequences of these behaviors as measured by heart rate, breathing rate, and pulse oximetry.

I am aware that I will be observed by two observers as I am feeding one of the hospitalized babies during a regularly scheduled feeding in the baby's room. I understand that the baby will be monitored by a cardiorespiratory monitor and that I will be asked to leave the monitor in operation throughout the feed. I also understand that the baby will be monitored by a pulse oximeter before, during, and after one feed. I am aware that I am being asked to feed the baby in the usual manner and allow the baby to assume any body position he/she desires throughout the feed.

I understand that the information gained from this study will be written in a thesis and be made available to other health professionals. This information may help nurses to feed babies with heart problems more efficiently. I understand that I may ask questions at any time.

I understand that participation in this study is strictly voluntary and involves no cost to me. I also understand that I will not be paid for my participation. I am aware that my name will not be used in any report and all data collected will be kept in a locked file.

Mary Lou Korpon has described to me what is going to be done, how it is going to be done, the risks, hazards and benefits involved, and will be available for questions at 844-1960. I understand that my decision to participate or not to participate in this study will not alter my usual health care. In the use of information generated from this study, my identity will remain anonymous. I am aware that I may withdraw from this study at any time. I further understand that in the event of physical injury or illness occurring to me resulting from the research procedures, University Hospitals will not provide free medical care or compensation for lost wages. Further information with respect to this topic is available from the Office of the Chief of Staff. I understand that by signing this consent form, I do not waive any of my legal rights nor does it relieve investigators or suppliers of liability, but merely indicates that I have been informed about the research study in which I am agreeing to participate. A copy of this form is available to me upon request.

Signature ___________________________ Age ______ Date __________________

Parent or Guardian Signature ___________________________ (If subject is a minor)

Witnessed by ___________________________ Date __________________

IM ___________________________ (Signature of Project Investigator)

(9/85)
APPENDIX C

DATA COLLECTION FORM
DATA COLLECTION FORM

Part I
Code #  Diagnosis
Data of Birth  Last recorded weight
Age  Medications
Sex

Pre Feed Data  (5 minutes pre feed)
HR  Infant activity
RR  Infant position
%SaO₂

* * * * *

Part III: Post Feed Data

<table>
<thead>
<tr>
<th>Time in Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>%SaO₂</td>
</tr>
<tr>
<td>HR</td>
</tr>
<tr>
<td>RR</td>
</tr>
<tr>
<td>Infant position</td>
</tr>
<tr>
<td>Infant activity</td>
</tr>
</tbody>
</table>

Key:
Activity:
S- sleeping  LL- left lateral
A- awake/attending  RL- right lateral
Q- quiet  S- supine
F/C- fussy/crying  P- prone
Su- semi-upright
**Part II- Feeding Data**

<table>
<thead>
<tr>
<th>Time in minutes</th>
<th>%SaO₂</th>
<th>HR</th>
<th>RR</th>
<th>Infant position</th>
<th>Caregiver activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>T₀</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₄</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₆</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₈</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₉</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₀</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₁</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₄</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₆</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₈</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₁₉</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₀</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₁</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₂</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₄</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₆</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₇</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₈</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₂₉</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T₃₀</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Part II—Feeding Data (con't)

Time at start of feed: _____

Time at end of feed: _____

# minutes spent in feeding: _____

Brief summary of characteristics of child:

**Key:**

**Infant position**

- SU- semi-upright
- LLH- Left lateral head movement
- RLH- Right lateral head movement
- AB- arched back
- HN- hyperextended neck
- U- upright

**Caregiver activity**

- PU- pick up
- Pd- put down
- HSFP- holding in standard feeding position
- PF- pause in feeding
- B- burping the infant
- RPI- repositioning infant during feed
REFERENCES


