Umbilical Cord Blood as Alternative for Infant Blood in Neonatal Sepsis Evaluation

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Introduction

The mission of the research-intensive hospital that is the site of this study is to provide personalized, comprehensive, and quality health care, enhanced by medical education and research. Providing services to meet the special needs of children has been an important part of this mission. Early onset Group B Streptococcus (GBS) sepsis is a leading cause of potentially preventable neonatal morbidity and mortality in the United States (Polin et al., 1981). Approximately 25-35% of neonates with a bacteremia develop adverse sequelae (Hansen, Forbes, & Buck, 2005). Signs and symptoms of neonatal sepsis are nonspecific. Awaiting clinical emergence of sepsis diminishes the opportunity for a successful outcome. Rapid and accurate detection of newborn infants with neonatal sepsis and early initiation of antibiotic therapy is essential to decreasing illness and death in newborns (Polin et al., 1981). Substitution of umbilical cord blood for infant blood to detect bacteremia would spare trauma to the infant and family, increase patient satisfaction, and provide improved utilization of time and resources. In order to recommend a change in the blood sampling source (umbilical blood versus infant peripheral site) for evaluation of sepsis, a large, paired sample population of term and preterm infants is necessary.

The purpose of this project is to perform a retrospective chart review to compare the complete blood count, immature to total (I:T) granulocyte ratio and blood culture results between
umbilical blood and infant blood. The assessment of correlation is to determine if umbilical cord blood is a valid alternative for infant blood for evaluation for group B streptococcus sepsis.

**Context**

- Early onset bacterial sepsis, primarily with group B streptococci (GBS) is a leading cause of potentially preventable neonatal morbidity and mortality in the United States. Long-term sequelae are frequently encountered in survivors of GBS sepsis (Hansen et al., 2005). Early-onset GBS infection results in approximately 80 deaths in the United States each year (Martin, Fanaroff, & Walsh, 2006).

- Currently both the complete blood count (CBC) and blood culture used to evaluate GBS sepsis status are drawn from a peripheral site of at-risk newborns (CDC, 2007). Often it is difficult to obtain an adequate volume of blood from neonates with small and delicate veins. An inadequate amount of blood inoculated in the blood culture bottle may yield a negative result or delay in the interpretation of bacterial growth (Polin et al., 1981). Health care providers with increased skills are needed to perform venipuncture of a neonate, and these highly skilled providers must leave other higher acuity tasks in order to obtain a newborn blood sample. Well infants at risk for GBS sepsis are removed from their family, disrupting the bonding process and causing distress to the family (Costakos, Walden, Rinzel, & Dahlen, 2009).

- Studying the possibility of utilizing umbilical cord blood as a source of blood for culture is not an original idea.

- In 1963, Pryles et al. reported a high incidence of false positive results from umbilical cord blood cultures. Of 150 neonates with positive cultures, 24 (11%) showed symptoms of infection. Contamination appeared to play a major role in this study. This study did not
define the method of obtaining cultures and there was no mention of whether the umbilical cord was prepared prior to obtaining the culture (Pryles, Steg, Sumati, Gellis, Tenney, 1963).

- A study in 1966 by Tyler & Albers, examined umbilical cultures only. Neonates were not cultured for comparison. Maternal infection was not identified as a criterion for infection. There were 30 positive cultures out of 319 (9.4%). Ten neonates showed signs of illness and only two infants had clinical illness. Nonpathogenic bacteria accounted for 10 (33%) of the positive cultures.

- In 1981, Polin et al. reported on using umbilical cord blood for detection of neonatal bacteremia. There were two hundred umbilical cultures obtained but only 29 neonatal cultures were obtained. Due to the small number of neonatal cultures to compare to umbilical cultures, it was difficult to conclude that umbilical cord blood cultures were a valid alternative. There were six positive cultures, two of which were late appearing (> 48 hours). There were two cultures which were considered contaminants, and one culture correlated with the infant’s blood.

- In 2005, a study by Hanson, Forbes, & Buck, 113 paired samples of cord blood and infant venous blood were compared, assessing the correlation of complete blood count (CBC)/differential and blood culture results. The population of this study was term infants only. The conclusion of this study was that cord blood could be safely substituted for infant flood in sepsis evaluations of asymptomatic term infants.
Project Description

Goals

The goal of this study is to evaluate the correlation of the complete blood count (CBC), immature to total (I:T) granulocyte ratio, and blood culture results between samples obtained from umbilical cord blood and samples obtained from infant peripherally drawn blood.

Research Questions

1. Research Question: Is the use of umbilical cord blood a valid alternative to peripherally drawn infant blood, as determined by Pearson correlation coefficient, in the evaluation of group B streptococcus sepsis in newborn infants?

2. PICO Question: In newborn infants at risk for group B streptococcus sepsis, are the results of the complete blood count and blood culture taken from umbilical cord blood valid, as compared to results of the currently acceptable practice of obtaining blood from a peripheral site of the infant?

Methodology

This will be an IRB approved (Texas Woman’s University, hospital) retrospective chart review to investigate the correlation of CBC, I:T ratio, and blood culture results between blood samples obtained from the umbilical cord and samples obtained from the infant for the purpose of neonatal sepsis evaluation. A convenience sample of 155 term and preterm infants that were born at the hospital site will be included in the study. The Umbilical Cord Blood Culture Study form (Appendix B) will be utilized for data collection. Inclusion criteria are: infants who were at risk for GBS sepsis based on maternal factors; infants who had CBC and blood cultures drawn from both umbilical cord and peripheral sites. Exclusion criteria are: infants whose blood sample was insufficient or clotted.
Data collection will include comparison of the following paired test results: complete blood count and blood cultures from neonate (standard practice); complete blood count and blood cultures from the umbilical cord. Data collection will also include: maternal history; birth weight, gestational age, and gender; type of resuscitation; time and site of neonatal blood sampling; time and site of umbilical blood sampling; blood volume of each sample; CBC results; blood culture results; whether infant developed GBS sepsis. Every fifth chart will be audited for data entry accuracy.

Statistical analysis: The agreement between the umbilical cord blood sample and neonatal sample with respect to CBC (White blood count, red blood count, hematocrit, polys, bands, I:T ratio, platelets) will be assessed by the Pearson correlation coefficient for each component and by comparing means using the paired t-test and McNemar’s test.

**Timeline and Duration**

This study is expected to run over six months.

<table>
<thead>
<tr>
<th>Date</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>August – October 2010</td>
<td>IRB approvals (Scott &amp; White and TWU)</td>
</tr>
<tr>
<td>October 2010 – February 2011</td>
<td>Collection of data using UCBCS form</td>
</tr>
<tr>
<td>February 2011</td>
<td>Statistical analyses</td>
</tr>
<tr>
<td>February – April 2011</td>
<td>Complete Capstone Project; author article</td>
</tr>
</tbody>
</table>

**Sites, Support and Personnel Required for Project**

The site will be a research-intensive Children’s Hospital. The personnel required will include the data collector (self), statistician, and editor. Access to charts will be necessary.

**Deliverables to Institution**

A study to compare CBC and blood culture results from the umbilical cord and infant blood for the purpose of sepsis evaluation is associated with potential reduction of painful
procedures to infants. Secondary outcomes would include improved patient/family satisfaction, improved time management for healthcare providers with resulting cost reduction.

**Benefits/Anticipated Outcomes**

A potential correlation could be shown for the use of umbilical blood as an alternative to infant blood for the purpose of sepsis evaluation. There could be a possible change of blood sampling source which would result in reduction of painful procedures for infants, decreased anxiety and improved patient satisfaction for parents, uninterrupted bonding between family and infant, and improved time management for healthcare providers.

A close correlation between blood culture results obtained from the umbilical cord and the neonate are anticipated. CBC results from umbilical cord are expected to be similar to peripherally drawn CBC. An expectation is that umbilical cord blood will become the valid and preferred site for blood sampling in the evaluation of neonatal infection.
References


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Appendix A

Research Question:

Is the use of umbilical cord blood a valid alternative to peripherally drawn infant blood, as determined by Pearson correlation coefficient, in the evaluation of group B streptococcus sepsis in newborn infants?

PICO Question:

In newborn infants at risk for group B streptococcus sepsis, are the results of the complete blood count and blood culture taken from umbilical cord blood valid, as compared to results of the currently acceptable practice of obtaining blood from a peripheral site of the infant?

Research Hypothesis:

There is no difference in the complete blood count and blood culture results between blood taken from the umbilical cord and blood taken peripherally from the infant, as determined by Pearson correlation coefficient.

Clinical Problem:

Early onset bacterial sepsis, primarily with group B streptococci (GBS) is a leading cause of potentially preventable neonatal morbidity and mortality in the United States. Long-term sequelae are frequently encountered in survivors of GBS sepsis. Early-onset GBS infection results in approximately 80 deaths in the United States each year. Signs and symptoms of neonatal sepsis are nonspecific. Awaiting clinical emergence of sepsis diminishes the opportunity for a successful outcome. Rapid and accurate detection of newborn infants with neonatal sepsis and early initiation of antibiotic therapy is essential to decreasing illness and death in newborns. Substitution of umbilical cord blood for infant blood to detect bacteremia
would spare trauma to the infant and family, increase patient satisfaction, and provide improved utilization of time and resources.

**Planned Instrumentation:**

The Umbilical Cord Blood Culture Study form will be utilized for data collection. This is an original data collection form for which reliability and validity will be assessed. No permission is required.

**Statistical Analysis:**

The agreement between the umbilical cord blood sample and neonatal sample with respect to CBC (White blood count, red blood count, hematocrit, polys, bands, I:T ratio, platelets) will be assessed by the Pearson correlation coefficient for each component and by comparing means using the paired t-test and McNemar’s test.
Appendix B

UMBILICAL CORD BLOOD CULTURE STUDY

(UCBCS)

1. Last 4 of MRN:_______________________
2. Sex:_________________________________
3. Birthweight:_______________________gms
4. Gestational Age:_______________________wks

CBC:

<table>
<thead>
<tr>
<th></th>
<th>Umbilical Cord</th>
<th>Neonatal</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-6.</td>
<td>WBC</td>
<td>_____________</td>
</tr>
<tr>
<td>7-8.</td>
<td>RBC</td>
<td>_____________</td>
</tr>
<tr>
<td>9-10.</td>
<td>Hbg</td>
<td>_____________</td>
</tr>
<tr>
<td>11-12.</td>
<td>Hct</td>
<td>_____________</td>
</tr>
<tr>
<td>13-14.</td>
<td>Platelets</td>
<td>_____________</td>
</tr>
<tr>
<td>15-16.</td>
<td>Polys</td>
<td>_____________</td>
</tr>
<tr>
<td>17-18.</td>
<td>Bands</td>
<td>_____________</td>
</tr>
<tr>
<td>19-20.</td>
<td>Lymphs</td>
<td>_____________</td>
</tr>
<tr>
<td>21-22.</td>
<td>Monos</td>
<td>_____________</td>
</tr>
<tr>
<td>23-24.</td>
<td>Meta</td>
<td>_____________</td>
</tr>
<tr>
<td>25-26.</td>
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<td>27-28.</td>
<td>NRBC’s</td>
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</tr>
<tr>
<td>29-30.</td>
<td>Eosinophils</td>
<td>_____________</td>
</tr>
<tr>
<td>31-32.</td>
<td>I:T Ratio</td>
<td>_____________</td>
</tr>
</tbody>
</table>

UMBILICAL CORD BLOOD CULTURE

33. Time of Blood Sampling From Delivery:_________________mins

34. Quantity__________________________mls

35-42. Culture Results: _______________Positive___________Negative

If Positive, mark which organism and indicate which day:
A. Group B Strep_____________ → Day_______________
B. E Coli____________________ → Day_______________
C. Other____________________ → Day_______________
   If Other, Specify_________________________________

43. Number of Neonatal Blood Cultures: (1 or 2)_______________

44. Age of Neonate at time of Blood Sampling:_______________mins

1ST NEONATAL BLOOD CULTURE  2ND NEONATAL BLOOD CULTURE

45-46. Site: (Mark one)  50-51. Site: (Mark one)

A. Antecubital_____________  A. Antecubital_____________
B. Hand__________________  B. Hand__________________
C. Radial Artery__________  C. Radial Artery__________
D. Scalp__________________  D. Scalp__________________
E. Foot___________________  E. Foot___________________
F. UAC___________________  F. UAC___________________
G. UVC___________________  G. UVC___________________
H. Other__________________  H. Other__________________
   If other, Specify_________  If Other, Specify_________

47. Quantity_______________ mls  52. Quantity_______________ mls

48-49. Culture Results: _____Positive  53-54. Culture Results: _____Positive
       _____Negative  _____Negative

55-63. If Positive, mark which organism and indicate which day:

A. Group B Strep_____________ → Day_______________
B. E Coli____________________ → Day_______________
C. Other____________________ → Day_______________
   If Other, Specify_________________
Positive culture number:_______1st_________2nd

Completed by:________________________Date:__________________
Appendix A
Appendix B