

12-2017

The Effects of Continuous Insulin Pump Therapy on Glycemic Control in Pregnant Type 1 Diabetics

Kimberly Kelsey

Dominican University of California

Follow this and additional works at: <http://scholar.dominican.edu/senior-theses>

 Part of the [Endocrine System Commons](#), [Endocrine System Diseases Commons](#), [Endocrinology Commons](#), [Endocrinology, Diabetes, and Metabolism Commons](#), [Female Urogenital Diseases and Pregnancy Complications Commons](#), [Health and Physical Education Commons](#), [Maternal, Child Health and Neonatal Nursing Commons](#), [Medical Education Commons](#), [Nursing Midwifery Commons](#), [Obstetrics and Gynecology Commons](#), and the [Therapeutics Commons](#)

Recommended Citation

Kelsey, Kimberly, "The Effects of Continuous Insulin Pump Therapy on Glycemic Control in Pregnant Type 1 Diabetics" (2017). *Senior Theses and Capstone Projects*. 70.
<http://scholar.dominican.edu/senior-theses/70>

This Senior Thesis is brought to you for free and open access by the Theses and Capstone Projects at Dominican Scholar. It has been accepted for inclusion in Senior Theses and Capstone Projects by an authorized administrator of Dominican Scholar. For more information, please contact michael.pujals@dominican.edu.

Running head: THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS

The Effects of Continuous Insulin Pump Therapy on Glycemic Control in Pregnant Type 1

Diabetics.

Kimberly Kelsey

Dominican University of California

Directed Research

NURS 4993

Dr. Luanne Linnard-Palmer

Spring 2017

Table Of Contents

Abstract	3
Acknowledgement	4
Introduction	5
Background	6
Problem Statement	8
Literature Review	8
Glucose Control During Labor and Delivery	9
Pregnancy Outcomes	10
Protocols For Practice	13
Mechanisms of Insulin Administration	15
Types of Insulin	18
Conclusion	19
Theoretical Framework	20
Research Proposal	21
References	23

Abstract

Type 1 Diabetics have various ways of managing their diabetes that have been studied for their effectiveness. Pregnancy in the Type 1 Diabetic has been understudied. It is known that Diabetics in general have poorer pregnancy outcomes because of poor glycemic control. This coupled with the fact that the body needs 3-4 times more insulin as pregnancy comes to an end makes managing blood glucose levels challenging for diabetics (Lowdermilk, 2016, p. 689). For the Type 1 Diabetic, there are two main ways to control diabetes: multiple daily injections using at least two type of insulin and continuous subcutaneous insulin injections, also known as an insulin pump, which uses one type of insulin. Research shows that insulin pump therapy increases the amount of control over blood glucose levels safely throughout all three terms of pregnancy. It also shows that insulin pump therapy is more effective than multiple daily injections at maintaining consistent blood glucose levels and lower H_{a1c} levels. Improvements need to be made at the labor and delivery level of care. Currently patients are put on an intravenous insulin drip once they enter into the hospital. Limited research has been preformed during this crucial time to see the safety and effectiveness of insulin pump therapy during this stage. One study showed that there was a higher percentage of success with regards to maintaining glucose levels in both mother and infant when an insulin pump was continued. These findings suggest that more research needs to be applied to the labor and delivery process of Type 1 Diabetics using insulin pumps to establish protocols for safety for both mother and baby.

Acknowledgements

I would like to thank my mom for always encouraging me to have as normal a life style as possible. Even though I was diagnosed with Type 1 Diabetes Mellitus at 2 years of age, she never wanted this disease to stop me. Because of her constant support, I have achieved so much. She is always in the background when I need her and I could not have gotten where I am today without her. Dr. Luanne Linnard-Palmer, no matter what situation, always provides encouragement and motivation. I want to thank her for being willing to sit with me when I wanted to know I was on the right tract.

Also, I would like to thank my partner Josh. Throughout our relationship including my time in nursing school he has been a constant support for me. Together we strive for excellence and encourage each other to do great things. He has learned my form of this disease and can often predict my blood sugar levels going low or high before I can. With his help, and the research put in for this thesis, I know he and I will have successful pregnancies in spite of the fact that I am a Type 1 Diabetic. His encouragement has meant so much to me and has helped me to complete what I find to be important work.

Introduction

According to the CDC (2015) approximately 29.1 million people or 9.3% of the population has diabetes. The CDC (2015) also estimates that there is an additional 8.1 million people who are undiagnosed with diabetes. Of the total 37.2 million people with diabetes, the CDC(2015) has found that only 5% have Type 1 Diabetes. Type 1 Diabetes is a disease in which the body attacks itself. In this case the body attacks specific cells that produce insulin and therefore insulin will no longer be produced. Insulin is a hormone that regulates how the body digests sugar. To compensate for the lack of insulin, Type 1 Diabetics administer insulin by taking a shot just under the skin. The amount of insulin required varies based on the person's sensitivity, health status and diet.

Currently there are two methods to administer insulin for Type 1 Diabetes: taking multiple injections a day or using a continuous insulin pump. When a diabetic takes shots there are multiple types of insulin that can be taken. The first one, that should be taken at the same time every day, is a long acting insulin that helps keep blood sugar levels stable for 24 hours. The second type is a fast acting insulin that is taken every time sugar or carbohydrates are eaten or when the blood sugar levels are high. This insulin lasts 3-4 hours. When using an insulin pump, the fast acting insulin is used and the insulin is injected via a tiny tube that goes just under the skin. The fast acting insulin is administered all day every day (mimicking the long lasting insulin) as well as at meal times and when the blood sugar level is high. Using an insulin pump prevents the diabetic from taking multiple injections every day; instead they change the site of administration every 3-4 days. The American Diabetes Association (2015) states that a

continuous insulin pump mimics the cells in the body that produce insulin and can improve control of blood sugar levels through its ability to mimic the cells.

In any form of diabetes, it is very important to maintain good blood sugar control. During pregnancy, maintaining as normal as possible blood sugar levels means a healthier outcome to mom and baby. When a Type 1 Diabetic is pregnant, the insulin demands go up approximately 3-4 times the non-pregnant state (Lowdermilk, 2016, p. 689). This increase in insulin also happens predominantly in the last 6 months of pregnancy according to Medtronic (2016). Control of Type 1 diabetes has been studied in the non-pregnant diabetic with advances being made constantly. Room for improvement lies with the pregnant diabetic and how to best manage blood sugar levels to achieve optimal health for both baby and mom.

Background

Pregnancy is a time of constant change and evolution for the fetus and pregnant women. For the type 1 diabetic, some of those changes include an increase in the amount of insulin needed and an increased in insulin resistance (Lowdermilk, 2016, p. 689).

While these changes start to happen in the second and third trimester, effects of glycemic control on the fetus start early and can have drastic effects on the fetus. Poor glycemic control, hypoglycemia or hyperglycemia can cause malformations of the vital organs of the fetus and as time progresses the baby could be born too large, small or be stillborn (Lowdermilk, 2016, p. 690).

Research done by the American Diabetes Association has found that type 1 diabetics have significantly higher rates of perinatal complications than the general public. Those diabetics with poor self care habits are at even higher risk of perinatal complications. The more a diabetic tests their blood glucose levels generally the better the glycemic control. But this is not always

the case as different forms of insulin have different durations of action. For example, when a type 1 diabetic is on insulin injections, there is a long acting insulin and a short acting insulin used. The long acting insulin generally lasts 18-24 hours, this means that this injection will remain active, and is not adjustable for the 18 to 24 hours. While this injection is meant to be a basal rate, it is a constant amount of insulin. This consistent amount can be too much at times causing hypoglycemia or too little and cause hyperglycemia.

The continuous insulin pump uses only fast acting insulin. The insulin is administered every hour and can be adjusted as needed. For example if the diabetic is experiencing hyperglycemia, the pump can be adjusted to administer more insulin for a short amount of time or permanently if needed. Since the insulin pump uses insulin that works for only 3-4 hours, adjustments can be made rapidly and tighter glycemic control can be achieved.

With relation to pregnancy, it is not suggested either way if a type 1 diabetic should be on a continuous insulin pump or insulin injections. The current method is to continue with insulin therapy under the guidance of an OBGYN and endocrinologist but how to administer the insulin is not explained. Everyday Health published an article titled “Having a Healthy Pregnancy With Type 1 Diabetes” where Vann (2013) stated that the diabetic should discuss medication changes, use continuous glucose monitor, plan for life when the baby comes, and use adequate contraception after the birth with their OBGYN and Endocrinologist. However this article, like many others lacks the information on which method is most effective for most people and how to deal with labor.

John Muir Health has a diabetes center where patients are sent for diabetes management. Nurses run the diabetes center and are the ones who make changes to how much insulin the type 1 diabetic is taking at any time, which does include pregnancy. If ever a need, the nurses can

consult the endocrinologists and the endocrinologists are informed of changes, but the nurses are the primary force helping the diabetics. Since the nurse is in so much control of the diabetics glycemic state, it is important to know which form of insulin administration will have the greatest impact on the to be mother and baby. In order to determine which method would be better to use, evidence must be examined and evaluated.

Problem Statement

Type 1 diabetic women who are pregnant have to decide between taking multiple injections every day or using an continuous insulin pump to manage their diabetes. While an insulin pump has been found to be more effective in glycemic management in the non-pregnant type 1 diabetic, there is a lack of evidence-based practice for type 1 diabetic insulin administration during pregnancy. This lack of evidence affects every type 1 diabetic women who is or is planning to become pregnant and wants to have as healthy a pregnancy possible for both her and her baby. As nurses it is important to know how to achieve euglycemia and which methods have been proven to be most effective. The purpose of this paper is to examine the effects of insulin therapy and continuous insulin pump therapy on pregnant type 1 diabetics to determine which results in better glycemic control for the diabetic.

Literature Review

Controlling the glucose levels in Type 1 Diabetics during pregnancy through the use of insulin pump therapy has not been sufficiently researched. Through extensive data base research using Iceberg, PubMed, Proquest Nursing and Allied Health Source, Cinahl, and Cochran Collection Plus, several articles were able to form a protocol of how to best manage Type 1 Diabetics blood glucose levels during pregnancy with the use of insulin pump therapy. These articles outlined glucose control during labor and delivery as well as pregnancy outcomes

relating to glycemic control. Also suggested were protocols for practice regarding insulin pump therapy. Finally, types of insulin and the mechanisms of insulin administration were written about in detail with regard to glycemic control in Type 1 Diabetics. Key words used to find these articles were insulin pump, pregnancy and Type 1 Diabetes Mellitus.

Glucose Control During Labor and Delivery

In the article *Glucose Control During Labor and Delivery*, Ryan and Al-Agha (Springer, 2013) explain the consequences of poor glycemic control and how the insulin pump and IV insulin differ. Explained first was how much glucose control in the 6 weeks leading up to pregnancy can make drastic differences in the formation of the fetus. Poor glycemic control, specifically hyperglycemia, can cause congenital malformations. Poorly controlled diabetes all through pregnancy can cause hyperglycemia in the fetus as well. This will result, as stated by Ryan and Al-Agha (2013), in pancreatic hyperplasia and fetal hyperinsulinemia. If continued through the labor and delivery process, the hyperglycemia in the mother can result in hypoglycemia in the neonate because the newborns body will not adjust as quickly to the decrease in blood glucose level. Adding to this increase in insulin production to compensate for the mothers hyperglycemia is the neonate's liver's inability to produce glucagon. Without glucagon production, the blood glucose level in the neonate will remain low and become possibly lower. It was found that a blood glucose level during the labor process of 180mg/dL or higher will result in hypoglycemia in the neonate. 145mg/dL or higher lead to 86% of neonates suffering from hypoglycemia and finally 90mg/dL only lead to 47% of neonates suffering from hypoglycemia. With a blood glucose level of 145 or higher, some infants required intravenous glucose to recover from the hypoglycemia (Ryan and Al-Agha, 2013).

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 10

Ryan and Al-Agha (2013) also found that intravenous insulin during labor has a success rate of 62-87% of keeping women in the target range of 60-90mg/dL while continuous insulin pump therapy had a solid success rate of 80%. While the insulin pump looks like an advantage because it has a less variable success rate, there were fewer patients who used an insulin pump. It is theorized that IV insulin administration is used more frequently because of a shorter half-life. Ultimately, IV insulin works well when used with IV glucose at the same time and this method results in less neonatal hypoglycemia rate by 7.3%.

To maintain optimal glucose control during the labor and delivery process, Ryan and Al-Agha (2013) found that blood glucose level should be maintained between 72 and 126mg/dL. To achieve this range, blood glucose should be checked every hour to two hours. IV access should be maintained to not only give glucose to make up for the calorie consumption during labor but also in case of hypoglycemia. All diabetics have a higher risk of cesarean section so providing calories via the IV route will decrease the risk of aspiration in the event of surgery.

This article by Ryan and Al-Agha (2013) implies that time management is essential in nursing care. To maintain the best blood glucose levels for the mother and baby, the blood sugar needs to be monitored as frequently as 1-2 hours. With this monitoring of blood glucose levels, in order to meet the strict guidelines of glucose control, insulin and glucose will need to be adjusted accordingly. Nurses will need to become educated and comfortable with Type 1 Diabetes Mellitus and the management through the use of an IV insulin drip or insulin pump.

Pregnancy Outcomes

Lappolla et. Al (2003) in the article *Analysis of outcome of pregnancy in type 1 diabetics treated with insulin pump or conventional insulin therapy* (2003) the effects of insulin pump therapy and multiple daily injections on pregnancy outcomes. Tight control was used in order to

maintain accurate results to compare insulin pump therapy and multiple daily injections. All of the participants, regardless of insulin administration type, administered regular insulin 30 minutes before meals unless they were using lispro insulin in which case the participant was to administer 0-5 minutes before.

Lappolla et.al (2003) found that both forms of insulin administration saw a decrease in post-prandial glucose levels when giving insulin 30 minutes before. There was an 11% decrease in blood glucose levels with participants taking multiple daily injections and a 19% decrease in blood glucose levels with insulin pump therapy. With regards to HgA1C levels, there was a decrease in the second and third trimester when patients used multiple daily injections where as there was an overall decrease in HgA1C in all three trimesters when patients used insulin pump therapy. Both groups of participants saw and increase in the need for insulin with the insulin pump participants needing more of an increase than the injections participants. This greater increase with insulin pump participants did not result in more hypoglycemic episodes.

Fetal malformations were found in Lappolla et. al research (2003) in one participant from the insulin pump group and three from the injections group. All four pregnancies that had malformations in the fetus started off their pregnancies by using multiple daily injections as their form of therapy. Metabolic control with these four pregnancies, with regard to their HgA1C levels, was between 7.8 and 8.4; the aim is to be at or below a HgA1C level of 7.

Even though the insulin pump participants in Lappolla et. al research (2003) required more insulin as their pregnancies progressed, there were no incidences of hypoglycemia that required hospitalization. On the other hand, there was one participant in the multiple daily injections group who was hospitalized due to hypoglycemia. The stability of glucose levels found with insulin pump therapy reduced the risk of hypoglycemia. Insulin pump therapy has been found

with this study to be able to stabilize glucose levels in unstable Type 1 Diabetic patients in both preconception and pregnancy.

In the article *Pregnancy Outcomes and Glycemic Control in Women With Type 1 Diabetes: a Retrospective Comparison Between CSII and MDI Treatment* by Talaviya et al (2013), preterm labor, abortion rate, HgA1c and Apgar scores were examined. All of the patients included in this study were selected before becoming pregnant, given either insulin pump therapy or multiple injections and were started on treatment at least 3-6 months before conception. HgA1c sores were lower from the pre-conception period through to post-partum in the insulin pump group. The group taking multiple daily injections had 5% of their participants go into preterm labor where as all of the insulin pump group carried their pregnancies to term. Also the rate of C-sections was similar in both groups, lower by 0.72% in the pump group.

Talaviya et al (2013) also found that insulin pump group had better results with the infants. The insulin pump group experienced higher Apgar scores at 1 and 5 minutes and there were 3% less abortions. Only 7% of the pump group's infants had hypoglycemia at birth where as the multiple daily injections group had 20% of their infants experience hypoglycemia. The insulin pump in this study was found to increase glucose control and safety for the participant. The pump has also decreased the chances of complications in pregnant Type 1 Diabetics in this study.

Ekbohm (2008) followed 213 women with Type 1 Diabetes Mellitus through their pregnancy to determine if HgA1c could predict preterm delivery and if anything helped to keep HgA1c in better control. Medical indications for preterm delivery often involved hypertension, fetal distress or excessive fetal growth. Theses medical indications were not included for analysis; every other preterm delivery was analyzed.

The HgA1c levels were analyzed at 10, 20 and 28 weeks resulting in the HgA1c at 28 weeks being the best predictor of preterm delivery (Ekbom, 2008). For each 1% increment in HgA1c level, the odds of preterm delivery (before 37 weeks) went up by 4.5%. Additionally for the same 1% increase in HgA1c level, the chances of delivering before 34 weeks was 5.1%. The women who delivered early had a higher prevalence of infection (15% vs 13%) and microralbuminuria without hypertension (23% vs 77%) than those women who delivered at term.

Theses preterm deliveries resulted in 69% of the infants being large for gestational age and 3 being stillborn (Ekbom, 2008). The placentas of the mothers with higher HgA1c's were larger and had larger amounts of immature villi. The women who used fast acting insulin primarily had better control of Their HgA1c levels and had less preterm deliveries.

These articles outlined the how effective insulin pump therapy and fast acting insulin is in the control of blood glucose levels and decreasing negative outcomes. Because insulin pump therapy has been found to be so effective, it is essential for nurses to become familiar with pump and their effects. More courses should be offered through pump manufactures for nurses. The patients get classes on how to manage and program pumps therefore nurses who may care for those patients should know how to work with the pump.

Protocols For Practice

In the article *A Standardized Protocol to Achieve Normoglycaemia During Labour and Delivery in Women With Type 1 Diabetes* by Lepercq et.al (2008), a protocol was determined for insulin delivery during labor and the effects of the protocol on the infant and mother. The study had both patients who were using an insulin pump and patients who were administering insulin though multiple daily injections though out their pregnancy. When it came to labor and delivery, the protocol established was to administer 10% dextrose at a constant flow of 80mL/hour

through 1 IV and a rapid acting insulin through another IV at 1unit/hr. Blood glucose was monitored hourly and if adjustments were needed, a sliding scale used to adjust the amount of insulin used. To prevent hypoglycemia in the infant, 0.3mg/kg of glucagon was administered at birth and each infant was fed formula for full term babies enhanced with glucose through a nasogastric tube.

Lepercq's et. al (2008) participants had an average blood glucose level at the start of labor at about 120mg/dl with the exception of a few outliers of 140mg/dl. Induced labor had a mean glucose level of 110mg/dl while spontaneous was 125mg/dl. The women who elected to have a C-section had a mean blood glucose level of 140; this was significantly higher than the other two groups. Hypoglycemia was seen in 13% of the infants even with the protocol. 43 of the hypoglycemic infants had to go to the NICU and 12 of those infants had to stay for more than 5 days.

According to Lepercq et.al (2008), this protocol had great advantages. First, while blood glucose levels were more stable with induced labor, most women were above range upon admission but were able to return to normal within a few hours. Glycemic control was significantly poorer with elective C-sections, but overall there was a greater decrease with hypoglycemia in the infants. Because of this, nurses in the labor and delivery unit have become comfortable with insulin drips. As for the infants, there should either be a NICU nurse available or the labor and delivery nurses should become comfortable with nasogastric tube placement on infants.

Mathiesen et. al (2013) researched changes in amount of insulin administered via insulin pump through bolus and basal rates. This study involved 123 women who were pregnant and had Type 1 Diabetes Mellitus. Of the 123 women, 27 were using an insulin pump and only 1 started

therapy after conception. On average, every woman had to adjust their insulin ratios every third day with the guidance of a medical care team. The pump was set to give insulin to achieve a blood glucose level of approximately 85mg/dl in order to maintain an HgA1c level of 5.6.

Mathiesen et. al (2013) found that carbohydrate to insulin ratio changed during pregnancy along with basal. For breakfast, pregnant women started off needing on average 1 unit of insulin for 12 grams of carbohydrate and later in their pregnancy they needed 1 unit for every 3 grams of carbohydrate. Lunch and dinner were similar in that 1 unit went from covering 12 grams to only covering 4-6 grams of carbohydrates. Basal rates on the other hand started off by decreasing in the first trimester and then increasing by at least 50% up until the 33rd week of pregnancy.

The results of Mathesen's et. al (2013) study revealed that women on both insulin pumps and multiple daily injections require similar increases in insulin. Both groups saw hypoglycemic moments; however, the insulin pump participants saw less severe hypoglycemic episodes by 4%. This study found that by monitoring the carbohydrates and using an insulin pump, Type 1 Diabetic women were able to have safe pregnancies.

The protocols for pregnancy and labor and delivery need more exploration. These researchers have found some policies that can be effective but more research needs to be done to find if these methods are best and if there are better algorithms. Nurses need to be educated in pump management both for pregnant and non-pregnant clients. The training on pump therapy is beneficial, as this will improve patient outcomes for both mother and baby.

Mechanisms of Insulin Administration

Drever, Tomlinson, Bai, and Feig (2016) compared the use of insulin pump therapy and intravenous insulin during labor and delivery. Three groups of women appeared in this

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 16

comparison: women who were on multiple daily injections who switched to IV insulin during labor, women on insulin pumps who remained on pumps, and women on pumps who switched to IV insulin during labor. For the insulin pump users, the patient made the choice at 36-38 weeks if they wanted to remain on insulin pumps during labor. Those women who stayed on insulin pump therapy were taught how to manage their own pump during labor.

Throughout pregnancy, better glycemic control was maintained with the pump users and this held steady through labor and delivery (Drever, Tomlinson, Bai, Feig, 2016). The women who started their pregnancy with a pump and remained on their pump through delivery had the best control. The average glucose level in the pump remaining on pump group was lower with no differences in the time spent hypoglycemic, in fact the group that remained on the pump stayed in the target glucose range for longer periods of time.

The type of insulin delivery method, insulin pump or IV, did not have much of an effect on the neonates (Drever, Tomlinson, Bai, Feig, 2016). What did have an effect on the neonates was the time spent in the target glycemic range. The women staying in glycemic range is associated with a decrease in neonatal hypoglycemia and a decrease in NICU admission postpartum. This study found that it is safe and effective to remain on an insulin pump during the labor and delivery process and remaining on the insulin pump may be better than switching to IV insulin for those who are already on a pump.

In Gabbe, Holing, Temple, and Brown's (2000) study, insulin pump therapy was compared to multiple daily injections for the benefits, risks, cost and patient satisfaction. Three groups were also formed in this study: group 1 consisted of women who started pump therapy when they were already pregnant, group 2 included women on multiple daily injections, and group 3 were women who started pump therapy before conception. In general, all three groups

had a decrease in their HgA1c scores as pregnancy progressed. Those women who started pump therapy after they were already pregnant did not see a decrease in glycemic control. A big factor in women starting pump therapy while pregnant was hypoglycemic events. There were 17 episodes of severe hypoglycemia, which required glucagon, before pump therapy was initiated. This same group saw only 2 episodes of hypoglycemia after the initiation of pump therapy. Group 2 also had some hypoglycemia reported but there were no severe hypoglycemia events in group 3. As for hyperglycemia, there were 2 episodes of diabetic ketoacidosis, both of which were in the first group.

Overall there was great satisfaction with the results of therapy. Neonates had similar results in all three groups (Gabbe, Holing, Temple, Brown, 2000). Birth weight and Apgar scores were the same and congenital abnormalities were only seen in groups 1 and 2. 18 of 19 women who returned surveys from group 1 continued pump therapy after pregnancy and have reported better glycemic control, easier insulin administration and better diet. The participants did not like the fact that they had to wear the pump on their bodies at all time and felt that it interrupted sexual time with their partners. As for cost, there was no significant difference in the amount of money that went towards healthcare during pregnancy pertaining to insulin pump therapy or multiple daily injections. Where there was a difference pertaining to healthcare was the number of antepartum admissions. Group 1 had 39, group 2 had 23, and group 3 had 4 antepartum admissions; however, this did not make a significant difference in the overall cost of care. Overall, pump therapy was found to be safe and effective as a form of insulin administration during pregnancy.

Stewart et. al, 2016, compared a closed-loop delivery system to traditional insulin pump therapy in the article *Closed-Loop Insulin Delivery During Pregnancy in Women with Type 1*

Diabetes. The participants were randomly assigned to either sensor augmented insulin pump therapy or a closed-loop insulin delivery system for overnight analysis for 4 weeks. The amount of time spent in the target glycemic range in the closed-loop system was higher at 74% while the sensor augmented pump was in range 59% of the time. There was no significant difference with regards to either group and hypoglycemia; however, there was less time spent in hyperglycemic moments by the closed-loop system. Some of the women who chose to stay on the closed-loop system continued its use through labor and delivery and were able to stay within range 73% of the time with no hypoglycemia.

The infants of the mothers in both groups saw similar outcomes with regards to size, hypoglycemia (Stewart et. al, 2016). 13 of the 16 pregnancies followed through labor and delivery had large for gestational age babies. 11 of these infants were also treated with intravenous glucose for hypoglycemia. The closed-loop system was found to be effective in maintaining blood glucose within range throughout pregnancy without increases in hypoglycemic events in those women who chose to stay on this method.

Insulin pump therapy and closed-loop pump therapy are effective in maintaining glycemic control throughout pregnancy. Because of this nurses and doctors should become familiar with insulin pumps and learn to not rely on insulin drips. The use of IV glucose should be effective in administering calories and aiding in the prevention of hypoglycemia. In order to educate nurses on the care of Type 1 Diabetics during pregnancy, there should be a competency training and testing regarding insulin administration and treatment for the mother and baby.

Types of Insulin

Imbergamo et. al studied the effectiveness of Glargine and NPH insulin administration in the pregnant women in 2008. For those women who stayed on multiple daily injections, took a

long acting insulin, such as Glargine and NPH, is essential to prevent ketoacidosis and hyperglycemia. There were no observable difference in the occurrence of complications like preeclampsia, hypoglycemic events and ketosis with Glargine and NPH (Imbergamo et. al, 2008). The use of Glargine was associated with lower HgA1c levels in the first trimester. Since Glargine was found to be significantly better in the first trimester, there was reason to believe that NPH was just as effective overall during pregnancy. Finally, with regards to the neonates, the Glargine treated mothers had 46% of the babies born large for gestational age whereas the NPH mothers only had 26% of their babies born large for gestational age.

Rapid acting insulin is preferred for tighter control. Rapid acting insulin is the type of insulin used in insulin pumps and for mealtime shots in those who take multiple daily injections. Those taking multiple daily injections are the only participants to use the long acting insulin. As the nurse, it is important to know how long these insulin's last and when the patient last administered it. It can affect the glucose levels in regards to when it wears off meaning that more insulin may be needed in the labor and delivery situation as soon as the long acting insulin wears off. Many factors affect glucose control including type of insulin and how long it lasts in the system.

Conclusion

Insulin pump therapy has been found to be an effective form of insulin administration throughout the course of pregnancy in Type 1 Diabetics. Since insulin pumps use rapid acting insulin, adjustments can be made faster to adapt to most lifestyles. The ease of adjustment and administration has lead to better HgA1c levels and glucose control. More research should be done with regards to the effects of insulin pump therapy on fetal growth and neonatal outcomes. Some reports show no difference between multiple daily injections and insulin pump therapy

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 20

with regard to neonatal outcome whereas other reports show that insulin pump therapy has better results. Research should also be focused on insulin pump therapy during the labor and delivery process. There is very little research to support the safety of using the insulin pump during the labor and delivery process. Where the insulin pump has been found to increase glycemic control, which can have a positive influence on neonatal outcome, better glycemic control during the labor process can have an impact on the neonate post partum. The research currently available reveals that insulin pump therapy can be very effective for glucose management throughout pregnancy.

Theoretical Framework

Dorothea E. Orem developed the Self-Care Deficit Nursing Theory between 1959 and 2001 (Orem, 2017). This theory encourages patients to take care of themselves assuming they are able to and will recover quickly. Some of the concepts include that patients are individuals and nursing is an action that unless the patient actually needs the help, they should be self reliant and responsible for their own care. Self-care and dependence on care are learned through society and a person's knowledge of potential health problems is needed in order for people to take charge of their own needs.

Type 1 Diabetics are a group of people who deal with a disease on a daily basis and need to provide self-care in order to live. This self-care happens 24 hours a day, 7 days a week nonstop regardless if they are sick or not. When it comes to pregnancy, these diabetics still provide self-care; however, this care changes multiple times a week and therefore some guidance is needed from health care professionals. Currently, when the labor portions starts, the nurse takes over the role of self-care for the diabetic. According to Orem's theory, this is unnecessary and the patient should continue to take care of themselves, with some precautions in place.

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 21

Nurses need to understand that Type 1 Diabetics live with this disease everyday and often know how to manage it better than anyone else. As the female diabetic wants to become pregnant, the nurse should educate the patient about how pregnancy will change their disease and how being a diabetic can affect the fetus. Where improvement is needed in nursing care lies in the labor and delivery portion of pregnancy: nurses take over caring for the diabetic when the patients are still able to care for themselves. Therefore more research needs to go into the effectiveness of insulin pump therapy during labor and delivery. This research will guide nurses following Orem's theory about self-care making the patient responsible for their own outcomes.

Research Proposal

The goal of this paper was to see the effects of multiple daily injections therapy and insulin pump therapy on pregnant Type 1 Diabetics to determine which method had better glycemic control. Results show that patients who used insulin pump therapy starting months before conception through the third term had the best glycemic control. Now the question that remains is what is the effectiveness of insulin pump therapy on glycemic control of the mother during the labor and delivery process. Limited information about the effectiveness of insulin pump therapy has been established in labor and delivery. Over the course of 3 years, there should be two groups of pregnant Type 1 Diabetics: patients who continue on insulin pump therapy through labor and delivery and patients who are converted to intravenous insulin and stop insulin pump therapy. Participants will have their blood glucose levels monitored hourly and insulin will be adjusted according to needs. The patients will also go through training before labor and delivery to know how to adjust the insulin pump according to their needs while in labor.

30 participants will be need for this study and they will be selected based on the use of insulin pump therapy starting before conception. Inclusions include HgA1c levels that remained

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 22

below 7 through the course of pregnancy. Exclusions include having a C-section because they will need to be switched to intravenous use at that point. Variables include the use of insulin pump therapy or intravenous insulin as a way of insulin administration. Instruments used will be hospital glucometers to monitor glucose levels. Glucose monitors are checked for accuracy regularly making the glucometer a valid and fast way to gain information. This testing method will have high validity because it is easily repeatable.

Possible candidates will be screened in the third trimester for used of insulin pump before pregnancy began and also stability of HgA1c before and throughout pregnancy. Upon inclusion into study the participant will decide if they would like to remain on their insulin pump through labor. If they choose to remain on their pump, they will be trained on how to manage their insulin pump through labor and delivery. The nurse(s) managing the patient during the labor and delivery process will use the hospital glucometer to measure glucose levels hourly. Once the data is collected on every participant, data analysis will be preformed comparing both groups.

Patients with type 1 diabetes who intend to become pregnant, the nurses and doctors who aid in the labor and delivery process, and endocrinologist who have Type 1 Diabetic patients who intend to become pregnant will benefit from this study. Increased control of blood glucose levels indicates better outcomes for the patient and infant. Knowledge of insulin pump therapy and its effects on labor and delivery could improve glucose control in the labor and delivery environment, which will decrease the amount of negative outcomes of pregnancy.

Reference

- 2014 National Diabetes Statistics Report. (2015, May 15). Retrieved January 28, 2017, from <https://www.cdc.gov/diabetes/data/statistics/2014statisticsreport.html>
- About Prediabetes & Type 2 Diabetes. (2016, July 19). Retrieved January 28, 2017, from <https://www.cdc.gov/diabetes/prevention/prediabetes-type2/index.html>
- Diabetes During Pregnancy. (n.d.). Retrieved February 10, 2017, from <https://www.johnmuirhealth.com/health-education/conditions-treatments/diabetes-articles/diabetes-during-pregnancy.html>
- Dorothea Orem - Nursing Theorist. (n.d.). Retrieved March 22, 2017, from <http://www.nursing-theory.org/nursing-theorists/Dorothea-E-Orem.php>
- Drever, E., Tomlinson, G., Bai, A. D., & Feig, D. S. (2016). Insulin pump use compared with intravenous insulin during labour and delivery: the INSPIRED observational cohort study. *Diabetic Medicine*, *33*(9), 1253-1259. doi:10.1111/dme.13106
- Ekbom, P., Damm, P., Feldt-Rasmussen, B., Feldt-Rasmussen, U., Jensen, D. M., & Mathiesen, E. R. (2008). Elevated third-trimester haemoglobin A1c predicts preterm delivery in type 1 diabetes. *Journal of Diabetes and its Complications*, *22*(5), 297-302. doi:10.1016/j.jdiacomp.2007.03.008
- Gabbe, S. G., Holing, E., Temple, P., & Brown, Z. A. (2000). Benefits, risks, costs, and patient satisfaction associated with insulin pump therapy for the pregnancy complicated by type 1 diabetes mellitus. *American Journal of Obstetrics and Gynecology*, *182*(6), 1283-1291. doi:10.1067/mob.2000.106182
- How to manage insulin during pregnancy. (n.d.). Retrieved January 28, 2017, from <https://www.medtronic-diabetes.co.uk/pregnancy-planning/insulin-through-pregnancy>

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN 24
PREGNANT TYPE 1 DIABETICS

Imbergamo, M., Amato, M., Sciortino, G., Gambina, M., Accidenti, M., Criscimanna, A., . . .

Galluzzo, A. (2008). Use of glargine in pregnant women with Type 1 diabetes mellitus: A case-control study. *Clinical Therapeutics*, 30(8), 1476-1484.

doi:10.1016/j.clinthera.2008.08.013

Insulin Pumps. (n.d.). Retrieved January 28, 2017, from <http://www.diabetes.org/living-with-diabetes/treatment-and-care/medication/insulin/insulin-pumps.html?referrer=https%3A%2F%2Fwww.google.com%2F>

Lapolla, A., Dalfra, M. G., Masin, M., Bruttomesso, D., Piva, I., Crepaldi, C., & . . . Fredele, D.

(2003) Analysis of outcome of pregnancy in type 1 diabetics treated with insulin pump or conventional insulin therapy. *Acta Diabetologica*, 40(3), 143 doi: 10.1007/s005 92-003-0103-

Lepercq, J., Abbou, H., Agostini, C., Toubas, F., Francoual, C., Velho, G., . . . Timsit, J. (2008).

A standardized protocol to achieve normoglycaemia during labour and delivery in women with type 1 diabetes. *Diabetes & Metabolism*, 34(1), 33-37.

doi:10.1016/j.diabet.2007.08.003

Lowdermilk, D. L., Perry, S. E., Cashion, M. C., Alden, K. R. (2016). *Maternity and Women's Health Care, 11th Edition* [VitalSource Bookshelf version]. Retrieved from

<https://pageburstls.elsevier.com/books/9780323430869>

Mathiesen, J. M., Secher, A. L., Ringholm, L., Nørgaard, K., Hommel, E., Andersen, H. U., . . .

Mathiesen, E. R. (2013). Changes in basal rates and bolus calculator settings in insulin pumps during pregnancy in women with type 1 diabetes. *The Journal of Maternal-Fetal & Neonatal Medicine*, 27(7), 724-728. doi:10.3109/14767058.2013.837444

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN 25
PREGNANT TYPE 1 DIABETICS

Outcomes in Type 1 Diabetic Pregnancies. (2004, March 17). Retrieved February 09, 2017, from
<http://care.diabetesjournals.org/content/27/12/2819>

Ryan, E. A., & Al-Agha, R. (2014). Glucose control during labor and delivery. *Current Diabetes Reports*. 14(1). 450. Doi:10.1007/s11892-013-0450-4

Stewart, Z. A., Wilinska, M. E., Hartnell, S., Temple, R. C., Rayman, G., Stanley, K. P., . . .

Murphy, H. R. (2016). Closed-Loop Insulin Delivery During Pregnancy in Women With Type 1 Diabetes. *Obstetrical & Gynecological Survey*, 71(12), 699-701.

doi:10.1097/01.ogx.0000510810.74035.90

Talaviva, P. A., Saboo, B. D., Joshi, S. R., Padhivar, J. N., Chadarana, H. K., Shah, S. J., . . .

Shah, A. N. (2013). Pregnancy outcome and glycemic control in women with type 1 diabetes: A retrospective comparison between CSII and MDI treatment. *Diabetes & Metabolic Syndrome: Clinical Research and Reviews*, 7(2), 68-71.

Doi:10.106/j.dsx.2013.02.032

Vann, M. R. (2013, November 13). Having a Healthy Pregnancy With Type 1 Diabetes.

Retrieved February 09, 2017, from <http://www.everydayhealth.com/type-1-diabetes/having-a-healthy-pregnancy-with-type-1-diabetes.aspx>

Www.joslin.org, J. D. (2017). Conversion Table for Blood Glucose Monitoring. Retrieved

March 17, 2017, from

http://www.joslin.org/info/conversion_table_for_blood_glucose_monitoring.html

Click to print this page now.

You have submitted the following abstract to Nursing Education Research Conference 2018 (NERC18). Receipt of this notice does not guarantee that your submission was complete, free of errors, or accepted for presentation.

Nursing Education Research Conference 2018 (NERC18)

The Effects of Continuous Insulin Pump Therapy on Glycemic Control in Pregnant Type 1 Diabetics

Kimberly Kelsey, SN

School of Nursing, Dominican University of California, Lafayette, CA, USA

Type 1 Diabetics have various ways of managing their diabetes that have been studied for their effectiveness. Pregnancy in the Type 1 Diabetic has been understudied. It is known that Diabetics in general have poorer pregnancy outcomes because of poor glycemic control. This coupled with the fact that the body needs 3-4 times more insulin as pregnancy comes to an end makes managing blood glucose levels challenging for diabetics (Lowdermilk, 2016, p. 689). For the Type 1 Diabetic, there are two main ways to control diabetes: multiple daily injections using at least two type of insulin and continuous subcutaneous insulin injections, also known as an insulin pump, which uses one type of insulin. Research shows that insulin pump therapy increases the amount of control the patient has over blood glucose levels safely throughout all three terms of pregnancy. (Ekbom, 2008; Lappolla et. al, 2003; Talaviya et al, 2013;) Research also shows that insulin pump therapy is more effective than multiple daily injections at maintaining consistent blood glucose levels and lower Ha1C levels (Ekbom, 2008; Lepercq's et. al, 2008; Mathiesen et al, 2013). Improvements need to be made in the hospital setting at the labor and delivery level of care. Currently patients are put on an intravenous insulin drip once they enter into the hospital. Limited research has been preformed during this crucial time to see the safety and effectiveness of insulin pump therapy during this stage. One study showed that there was a higher percentage of success with regards to maintaining glucose levels in both mother and infant when an insulin pump was continued (Ryan, Al-Agha, 2013). These findings suggest that more research needs to be applied to the labor and delivery process of Type 1 Diabetics using insulin pumps to establish protocols for safety for both mother and baby.

Title:

The Effects of Continuous Insulin Pump Therapy on Glycemic Control in Pregnant Type 1 Diabetics

Submitter's E-mail Address:

kmb.rn10@gmail.com

Abstract Describes:

Completed Work/Project

Preferred Presentation Format:

Oral

Applicable category:

Academic, Students, Researchers

Keywords:

Insulin Pump Therapy, Pregnancy and Type 1 Diabetes Mellitus

References:

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 27

2014 National Diabetes Statistics Report. (2015, May 15). Retrieved January 28, 2017, from <https://www.cdc.gov/diabetes/data/statistics/2014statisticsreport.html>

About Prediabetes & Type 2 Diabetes. (2016, July 19). Retrieved January 28, 2017, from <https://www.cdc.gov/diabetes/prevention/prediabetes-type2/index.html>

Diabetes During Pregnancy. (n.d.). Retrieved February 10, 2017, from <https://www.johnmuirhealth.com/health-education/conditions-treatments/diabetes-articles/diabetes-during-pregnancy.html>

Dorothea Orem - Nursing Theorist. (n.d.). Retrieved March 22, 2017, from <http://www.nursing-theory.org/nursing-theorists/Dorothea-E-Orem.php>

Drever, E., Tomlinson, G., Bai, A. D., & Feig, D. S. (2016). Insulin pump use compared with intravenous insulin during labour and delivery: the INSPIRED observational cohort study. *Diabetic Medicine*, *33*(9), 1253-1259. doi:10.1111/dme.13106

Ekbom, P., Damm, P., Feldt-Rasmussen, B., Feldt-Rasmussen, U., Jensen, D. M., & Mathiesen, E. R. (2008). Elevated third-trimester haemoglobin A1c predicts preterm delivery in type 1 diabetes. *Journal of Diabetes and its Complications*, *22*(5), 297-302. doi:10.1016/j.jdiacomp.2007.03.008

Gabbe, S. G., Holing, E., Temple, P., & Brown, Z. A. (2000). Benefits, risks, costs, and patient satisfaction associated with insulin pump therapy for the pregnancy complicated by type 1 diabetes mellitus. *American Journal of Obstetrics and Gynecology*, *182*(6), 1283-1291. doi:10.1067/mob.2000.106182

How to manage insulin during pregnancy. (n.d.). Retrieved January 28, 2017, from <https://www.medtronic-diabetes.co.uk/pregnancy-planning/insulin-through-pregnancy>

Imbergamo, M., Amato, M., Sciortino, G., Gambina, M., Accidenti, M., Criscimanna, A., . . . Galluzzo, A. (2008). Use of glargine in pregnant women with Type 1 diabetes mellitus: A case-control study. *Clinical Therapeutics*, *30*(8), 1476-1484. doi:10.1016/j.clinthera.2008.08.013

Insulin Pumps. (n.d.). Retrieved January 28, 2017, from <http://www.diabetes.org/living-with-diabetes/treatment-and-care/medication/insulin/insulin-pumps.html?referrer=https%3A%2F%2Fwww.google.com%2F>

Lapolla, A., Dalfrà, M. G., Masin, M., Bruttomesso, D., Piva, I., Crepaldi, C., & . . . Fredele, D. (2003). Analysis of outcome of pregnancy in type 1 diabetics treated with insulin pump or conventional insulin therapy. *Acta Diabetologica*, *40*(3), 143 doi: 10.1007/s005 92-003-0103-

Lepercq, J., Abbou, H., Agostini, C., Toubas, F., Francoual, C., Velho, G., . . . Timsit, J. (2008). A standardized protocol to achieve normoglycaemia during labour and delivery in women with type 1 diabetes. *Diabetes & Metabolism*, *34*(1), 33-37. doi:10.1016/j.diabet.2007.08.003

Lowdermilk, D. L., Perry, S. E., Cashion, M. C., Alden, K. R. (2016). *Maternity and Women's Health Care, 11th Edition*[VitalSource Bookshelf version]. Retrieved from <https://pageburstls.elsevier.com/books/9780323430869>

Mathiesen, J. M., Secher, A. L., Ringholm, L., Nørgaard, K., Hommel, E., Andersen, H. U., . . . Mathiesen, E. R. (2013). Changes in basal rates and bolus calculator settings in insulin pumps during pregnancy in women with type 1 diabetes. *The Journal of Maternal-Fetal & Neonatal Medicine*, *27*(7), 724-728. doi:10.3109/14767058.2013.837444

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 28

Outcomes in Type 1 Diabetic Pregnancies. (2004, March 17). Retrieved February 09, 2017, from <http://care.diabetesjournals.org/content/27/12/2819>

Ryan, E. A., & Al-Agha, R. (2014). Glucose control during labor and delivery. *Current Diabetes Reports*, 14(1), 450. Doi:10.1007/s11892-013-0450-4

Stewart, Z. A., Wilinska, M. E., Hartnell, S., Temple, R. C., Rayman, G., Stanley, K. P., . . . Murphy, H. R. (2016). Closed-Loop Insulin Delivery During Pregnancy in Women With Type 1 Diabetes. *Obstetrical & Gynecological Survey*, 71(12), 699-701. doi:10.1097/01.ogx.0000510810.74035.90

Talaviva, P. A., Saboo, B. D., Joshi, S. R., Padhivar, J. N., Chadarana, H. K., Shah, S. J., . . . Shah, A. N. (2013). Pregnancy outcome and glycemic control in women with type 1 diabetes: A retrospective comparison between CSII and MDI treatment. *Diabetes & Metabolic Syndrome: Clinical Research and Reviews*, 7(2), 68-71. Doi:10.106/j.dsx.2013.02.032

Vann, M. R. (2013, November 13). Having a Healthy Pregnancy With Type 1 Diabetes. Retrieved February 09, 2017, from <http://www.everydayhealth.com/type-1-diabetes/having-a-healthy-pregnancy-with-type-1-diabetes.aspx>

Www.joslin.org, J. D. (2017). Conversion Table for Blood Glucose Monitoring. Retrieved March 17, 2017, from http://www.joslin.org/info/conversion_table_for_blood_glucose_monitoring.html

Abstract Summary:

Optimal glycemic control is necessary in the pregnant Type 1 Diabetic to promote the health of the mother and baby. This thesis focuses on the best way to control blood glucose levels during pregnancy.

Content Outline:

Introduction:

- a. Review the promenance of Diabetes Mellitus and the percentatges of type 1 diabetics.
- b. Review how pregnancy affects the Type 1 Diabetics.

Purpose:

To explore how to best care for pregnant Type 1 Diabetics from conception throughout labor and delivery with regard to glycemic control.

Main Points:

1. Insulin pumps have been found to be more effective in controlling blood glucose levels than multiple daily injections.
2. Insulin pump users had lower Hemoglobin A1C levels and consistantly lower blood glucose levels than those who used multiple daily injections.
3. There were less insidences of severe Hypoglycemia, DKA and fetal malformation in patients who used insulin pumps.

Conclusion:

THE EFFECTS OF CONTINUOUS INSULIN PUMP THERAPY ON GLYCEMIC CONTROL IN PREGNANT TYPE 1 DIABETICS 29

1. More research needs to be done with regards to the use of insulin pump therapy effectiveness during labor and delivery.
2. Protocols need to be created that can be used in any hospital for the care and management of Type 1 Diabetics in Labor.

Topic Selection:

Meta-Analysis Studies

First Primary Presenting Author

Primary Presenting Author

Kimberly Kelsey, SN

Email: kmb.rn10@gmail.com -- Will not be published

Alternate Email: km_kelsey90@yahoo.com -- Will not be published

Dominican University of California

School of Nursing

Nursing Student

3313 betty lane

lafayette CA 94549

USA

Professional Experience: Maternity BSN Clinical Rotation August 2016-December 2016 Sutter Santa Rosa- Worked with a type 1 Diabetic and baby through the labor and delivery process. Maternity Internship Summer 2017- Kaiser Antioch- Gained more experience in the perinatal ward of the hospital.

Author Summary: This is Kimberly Kelsey who has recently graduated from Dominican University with her BSN. During her course of study, she wrote a thesis where she analyzed how to best control blood glucose levels in the pregnant Type 1 Diabetic.

Any relevant financial relationships? No

Signed on 05/31/2017 by *Kimberly Kelsey NS*

If necessary, you can make changes to your abstract between now and the deadline of **Thursday, June 15 2017**

- To access your submission in the future, use the direct link to your abstract submission from one of the automatic confirmation emails that were sent to you during the submission.
- Or point your browser to </stti/reminder.cgi> to have that URL mailed to you again. Your username/password are 88964/680903.

Any changes that you make will be reflected instantly in what is seen by the reviewers. You DO NOT need to go through all of the submission steps in order to change one thing. If you want to change the title, for example, just click "Title" in the abstract control panel and submit the new title.

When you have completed your submission, you may close this browser window.

[Tell us what you think of the abstract submittal](#)

[Home Page](#)