

Nursing Professional Development

Self-Learning Package

Neonatal Hypoglycemia

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Directives

The College of Nursing of Ontario (CNO), the College of Physicians and Surgeons of Ontario and the Ontario College of Pharmacists support the use of directives. Correctly used, directives are an excellent means to provide timely, effective and efficient patient care. Directives utilize the expertise of both the professional who orders the directive and the nurse who utilizes discretion and judgment when implementing it.

Directives are comprehensive orders by the physician/nurse practitioner to other health care providers. They pertain to any patient who meets the criteria that has been defined within the directive. The directive contains the delegation and authority to carry out the specified treatments, interventions or procedures for a number of patients when specific conditions are met and when specific circumstances exist. A directive is always written.

This directive provides the nurse with the authority to perform blood glucose testing to the newborn infant without a direct (client specific) order.

The Nurse who initiates this directive is responsible for the following:

- Ensuring informed consent has been obtained
- Assessing the patient to determine whether the specified patient conditions have been met and any limitations or contraindications have been identified
- Knowing the risks to the patient of implementing the directive
- Possessing the knowledge, skill and judgment required to safely implement the directive
- Knowing the predictability of the outcomes of the intervention
- Determining whether management of the possible outcomes is within the scope of his/her practice; if so, whether he/she is competent to provide such management and if not, whether the appropriate resources are available to assist as required
- Knowing to contact the health care provider responsible for the patient if orders require clarification
- Knowing to contact the health care provider if any adverse event occurs as a result of implementing this directive

Further information on directives is available in the College of Nurses of Ontario standard, Directives (Revised 2014) found in the Compendium of Standards of Practice for Nurses in Ontario. Information is also available from the Federation of Health Regulatory Colleges of Ontario at <http://www.medicaldirectives-delegation.com/why/>.

Objectives

At the conclusion of the self-learning package, the learner will have:

- The knowledge to make critical decisions about when to implement the directive
- The clinical skills and judgement to implement the directive correctly and safely

Upon completion of this self-learning package, the learner will:

- Describe the etiology of neonatal hypoglycemia
- Identify the rationale for monitoring asymptomatic at risk newborns
- Describe the clinical signs and symptoms of neonatal hypoglycemia
- Identify the appropriate timing of blood glucose monitoring
- Demonstrate correct indications and procedure for the medical directive implementation

Neonatal Hypoglycemia

Definition

The term hypoglycemia refers to a low blood glucose concentration. Neonatal hypoglycemia cannot be defined by a single value applicable to all clinical situations and to all neonates because there may be differences due to their physiologic immaturity and their current pathophysiology. Definitions of neonatal hypoglycemia have been controversial and no uniform standard exists. The Canadian Paediatric Society (CPS) has defined operational thresholds but for the purposes of this manual a blood glucose concentration of less than 2.6 mmol/L is considered abnormal for both term and preterm infants within 72 hours of birth and requires intervention, after 72 hours of age the therapeutic goal for glucose levels is greater than or equal to 3.3 mmol/L (Canadian Paediatric Society , 2019).

Newborn Glucose Physiology

In utero, the fetus depends on the maternal supply of glucose. At birth the maternal supply is cut off and newborns experience an initial decrease in serum glucose until they can adapt to endogenous glucose metabolism. Most newborns will experience a low blood glucose between 30 and 90 minutes of life, followed by a slow and gradual rise. All newborns are expected to follow a similar pattern, regardless of the method of feeding chosen. Initiation of early feeds (within the first hour of life) will support the newborn by maintaining blood glucose and preventing a dramatic fall in levels. Glucose is the primary source of fuel for the newborns brain and there is a risk of long term neurological damage with prolonged hypoglycemia that is not corrected.

Newborns at risk for hypoglycemia

Causes of hypoglycemia can be related to diminished hepatic glucose, which leads to transient hypoglycemia, or conditions that are associated with excessive insulin production leading to recurrent hypoglycemia. The most common maternal factors for **transient hypoglycemia** include intrapartum administration of glucose and diabetes (both pre-existing and gestational). The use of beta blockers has been shown to have an effect on blood glucose and maternal use of labetalol has been correlated with increased instances of neonatal hypoglycemia (Thorton, et al., 2015). Many factors are unknown in the relationship between beta blockers and hypoglycemia but it is hypothesized that the medication may cause a reduced insulin-mediated glucose uptake and inhibits insulin secretion from the pancreas (Mazkereth, et al., 2019). There is also an increased correlation of intrauterine growth restriction with beta blocker use that may lead to a newborn who is small for gestational age, thereby putting them at risk for hypoglycemia (Mazkereth, et al., 2019). Neonatal factors include intrauterine growth restriction, small for gestational age, large for gestational age, prematurity, perinatal stress, cold stress, sepsis, congenital heart disease and congestive heart failure.

Recurrent hypoglycemia is secondary to excessive insulin production which can be related to several different conditions including enzyme disorders, endocrine disorders, Rh incompatibility and inborn errors of metabolism. It is important to recognize that most causes of neonatal hypoglycemia are multifactorial and can involve “1) insufficient glycogen stores, 2) inadequate glucose production, 3) inability to synthesize glucose, 4) increased glucose utilization, and/or 5) excessive insulin production” (Puchalski, Russell, & Karisen, 2018).

The following newborns at QHC will be identified as being at risk for hypoglycemia and will be routinely screened for blood glucose levels:

- Infants of diabetic and gestational diabetic mothers
- Maternal use of labetalol during pregnancy
- Prematurity (Less than 37 completed weeks gestation)
- Small for gestational age (SGA)
- Large for gestational age (LGA)

Gestation (completed weeks)	Birth Weight (grams)			
	10 th Percentile (SGA)		90 th Percentile (LGA)	
	Male	Female	Male	Female
37	2,552	2,452	3,665	3,543
38	2,766	2,658	3,877	3,738
39	2,942	2,825	4,049	3,895
40	3,079	2,955	4,200	4,034
41	3,179	3,051	4,328	4,154
42	3,233	3,114	4,433	4,251

Clinical Signs of Hypoglycemia

Untreated hypoglycemia may result in long-term neurological complications therefore immediate identification and intervention are essential. Signs of hypoglycemia are often subtle, usually neurological in nature and often there are a cluster of signs. They are not unique to hypoglycemia however blood glucose should be checked immediately when any these signs are observed in the newborn:

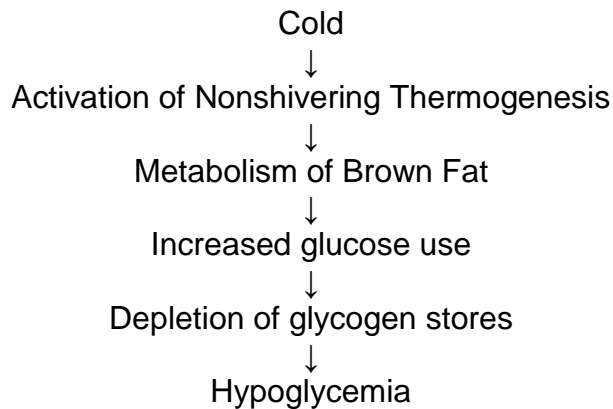
- Tremors or jitteriness
- Irritability
- Hypothermia, poor temperature control, sweating
- Poor suck, poor feeding or intolerance of feedings
- Hypotonia, limpness or lethargy
- Abnormal cry (weak or high-pitched)
- Abnormal eye movements
- Exaggerated Moro reflex
- Tachypnea, grunting, respiratory distress, apnea
- Cyanosis, pallor
- Seizures, coma or cardiac arrest

When a newborn exhibits any clinical signs of hypoglycemia they should be assessed promptly by the health care provider. Newborns exhibiting jitteriness only will have their blood glucose checked immediately and interventions will be taken as outlined in the Hypoglycemia in Inpatient Newborns Clinical Protocol. When signs of hypoglycemia are recognized in a newborn they must be documented in the patient chart. Following any type of intervention used to raise blood glucose, documentation will occur to confirm whether or not the signs remain.

Prevention of Hypoglycemia in the Newborn

Prevention of hypoglycemia is essential to preventing any long term sequelae in the newborn. Successful transition to extra uterine life, including normal blood glucose homeostasis, is facilitated by minimizing stress, maintaining normothermia, skin to skin contact and initiating early feeds as soon as the mother baby dyad is clinically stable. Colostrum contains high amounts of glucose to assist in the stabilization of blood glucose levels in newborns. Most newborns experience a transient episode of low blood glucose that can easily be corrected through feeding.

Thermoregulation is another important method of preventing hypoglycemia in the newborn. Promotion of skin to skin helps to prevent heat loss in the initial period of transition of the newborn. The first 10 to 20 minutes of life is the quickest period of cooling for a newborn and can be as much as 2-4 degrees when appropriate measures to prevent heat loss are not taken. Hypothermia and cold stress can lead to increased oxygen consumption resulting in respiratory distress and increased metabolism which depletes glucose stores resulting in hypoglycemia.



Newborn Blood Glucose Monitoring

Healthy term newborns with a normal perinatal course that are asymptomatic and not considered at risk do not require routine monitoring of glucose levels. Early feeding and promotion of thermoregulation through skin to skin contact to promote glucose homeostasis are important for all newborns to support their transition to extra uterine life.

Serum blood glucose concentrations show a cyclic response to an enteral feed, reaching a peak by about an hour after the feed, and the lowest blood glucose occurring just before the next feed is expected. Since the purpose of blood glucose monitoring is to identify the lowest blood glucose level, the measurement should be taken immediately before a feed (pre-feed).

Newborns identified as being at risk for hypoglycemia will be screened for hypoglycemia at **2 hours of age**. Continue to monitor every 3 to 6 hours, before feeds, until blood glucose is greater than or equal to 2.6 mmol/L as long as the newborn remains well.

Newborns displaying jitteriness suggestive of hypoglycemia at any age should be tested by capillary heel puncture immediately. Interventions will be dependent on the result however any blood glucose less than 2.6 mmol/L requires intervention.

Blood glucose samples can be collected by capillary heel puncture or venous sample. The primary method of collection should be by capillary heel puncture to reduce discomfort experienced with the procedure. Venous samples should be collected when a large volume of blood is required for additional tests that may be ordered. Ensure pain management techniques are used with any painful procedure in a newborn. The unit glucometer or point of care machine can be used for testing of a capillary sample. It is important to note that the glucometer provides a lower threshold for results than the point of care machine and there is no difference in accuracy of the machines. It is normal to have a 10% variance between devices and the complete clinical picture should be considered when making care decisions. If a critical low result is obtained you

must collect a second sample from a new site to confirm the result. Do not delay treatment while waiting for results. For the neonatal population, a critical low value is below 2.0 mmol/L.

***Refer to the Prevention of Hypoglycemia in Inpatient Newborns Clinical Protocol for further interventions related to blood glucose results and discontinuation of blood glucose monitoring ***

Blood collection technique- Capillary Heel Puncture

- Identify site to be punctured –The lateral aspects of the heel on the plantar surface are to be used for heel puncture. It is important to recognize that a poorly perfused extremity may not accurately reflect the blood glucose and warming of the heel should occur to increase blood flow and improve collection technique. If concerns arise regarding accuracy of a capillary sample due to perfusion of the extremity, a venous sample can be collected to confirm results.



- Gather supplies required for heel puncture: Alcohol swab, sterile gauze, lancet, band-aid, pipette if using point of care testing, glucose strip if using glucometer. Glucose can be tested on both the glucometer or the point of care machine. *Note- if result is less than 2.0 mmol/L you must collect a second sample for confirmation.
- Warm heel with approved heel warmers prior to testing to encourage blood flow
- Wash hands and apply gloves
- Clean site with alcohol swab and allow to dry completely
- Place lancet against selected site firmly and pierce the skin
- Wipe away first drop of blood with sterile gauze
- Apply intermittent pressure as far away from the puncture site as possible to promote blood flow and collect sample as required
- Apply pressure to site with gauze and apply band-aid
- Obtain result from point of care device

Treatment strategies

The goal of treatment is to prevent prolonged hypoglycemia, preventing any long term neurological effects. Skin to skin can be used to promote normothermia and establishment of breastfeeding, thereby helping to maintain a normal blood glucose in the newborn. Treatment strategies for at risk and symptomatic newborns aim to normalize blood glucose levels. These can include more frequent breastfeeding, oral dextrose administration, enteral feedings, intravenous (IV) glucose infusion and pharmacotherapy. The newborn's clinical condition will direct which interventions are most appropriate and expected interventions are provided in the medical directive and clinical protocol for hypoglycemia in the newborn.

Assisting mothers to establish breastfeeding is essential to promote effective transfer of milk from the mother to the newborn. If effective breastfeeding does not occur it is important to assist mothers in hand expression to provide milk to the newborn through alternative methods including cup, spoon, syringe or enteral feedings. Oral dextrose gel 40% can be given in addition to breastfeeding to improve blood glucose concentrations while keeping the mother baby dyad together and preventing disruption in breastfeeding through separation. Reduced maternal anxiety will improve successful breastfeeding rates. Dextrose gel should be considered first line treatment for hypoglycemia in the newborn and is administered based on weight (see dosing chart below). "40% dextrose gel has been shown to be more effective than feeding alone for reversal of neonatal hypoglycemia in at-risk late preterm and term babies in the first 48 hours after birth" (Harris, Weston, Signal, Chase, & Harding, 2013) and has shown a reduction in admissions to neonatal intensive care units. The gel is administered to the buccal mucosa to reverse hypoglycemia and shows a similar absorption rate to that of IV administration. Intrabuccal 0.5 mL/kg of 40% dextrose gel provides 200 mg/kg of glucose, equivalent to an IV bolus of 2 mL/kg of D10W solution (Canadian Paediatric Society , 2019). Studies have shown that newborns did not exhibit rebound hypoglycemia but have improved maintenance of blood glucose levels over a longer time frame (Bennett, Fagan, Chaharbakhshi, Zamfirova, & Flicker, 2016). Dextrose gel is administered by nursing staff in conjunction with breastfeeding, it is not intended to replace the feeding and is compatible with exclusive breastfeeding. If more than two doses of dextrose gel are required, the health care provider must be notified prior to any additional administration.

Dextrose 40% Gel Dosing Table	
Birth Weight	Dextrose 40% Gel Dose Volume
1760 – 2099 grams	1 mL
2100 - 2509 grams	1.2 mL
2510 - 3199 grams	1.4 mL
3200 - 4199 grams	1.8 mL
4200 - 5500 grams	2.4 mL

IV therapy should be initiated for blood glucose less than 1.8 mmol/L and persistent low blood glucose levels not responding to interventions. Administration of a 10% dextrose solution at a total fluid intake of 80 mL/kg/day should be infused until

hypoglycemia is reversed. Infusion rates should be titrated to maintain a blood glucose greater than or equal to 2.6 mmol/L. As feedings are introduced, the infusion can be titrated down slowly to avoid any rebound in blood glucose as the newborn transitions to exclusive feedings.

Termination of Glucose Monitoring

Termination of glucose monitoring is determined based on the indication for implementation of the clinical protocol.

Infants at risk for hypoglycemia should have regular glucose monitoring until their glucose is stable and they are no longer within the risk period for developing subsequent hypoglycemia. Feedings should be established to support ongoing glucose homeostasis. Glucose monitoring can be discontinued for at risk newborns when three consecutive glucose checks are greater than 2.6 mmol/L AND

- LGA/Infants of diabetic mothers: the infant is greater than 12 hours of age
- SGA/Maternal use of labetalol during pregnancy/Preterm < 37 weeks: the infant is greater than 36 hours of age

The clinical protocol is not to be terminated until the newborn has reached the identified age, feeding or feeding plan has been established and ongoing monitoring for hypoglycemia is no longer required.

Infants found to be symptomatic with low blood glucose require an order from the health care provider to terminate the clinical protocol.

Documentation

Following QHC documentation policy 3.12.7 and CNO standards, the nurse will document the appropriate assessments, treatments and patient responses and outcomes in the patient chart and ensure the medical directive order set is completed and placed on the patient's chart. The clinical protocol for prevention of hypoglycemia of the inpatient newborn is to be placed on the chart and signed by the health care provider as soon as able.

Competency Assessment – Neonatal Hypoglycemia

Refer to your online e-Learning for completion of your competency assessment for the Neonatal Hypoglycemia Medical Directive. This competency assessment will be your statement of competency and indicates you have completed a review of this manual and can safely implement the medical directive as outlined. This statement of competency must be renewed every year.

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