HYPOGLYCAEMIA – MONITORING AND MANAGEMENT OF HIGH RISK NEONATES

This LOP is developed to guide clinical practice at the Royal Hospital for Women. Individual patient circumstances may mean that practice diverges from this LOP.

1. AIM

- Early identification of at risk neonates, timely investigations and interventions for hypoglycaemia among neonates

2. PATIENT

- Newborns

3. STAFF

- Midwifery, nursing and medical staff

4. CLINICAL PRACTICE

Identification of high risk neonates

- Neonates of diabetic mothers; late preterm (34+0 to 36+6 weeks); small for gestational age (SGA – birth weight less than 10th percentile); large for gestational age (LGA – birth weight greater than 97th percentile or 4500 g at term).
- Determine if diabetes in mother is poorly controlled (as assessed by the obstetric team, physician/endocrinologist or by elevated fructosamine or HbA1C ≥6.5%, or elevated maternal blood glucose level (BGL) >8 mmol/L at delivery). Refer to maternal diabetes care plan.

At Delivery

- Commence skin-to-skin contact between the mother and her baby as soon as possible after birth.
- Commence breastfeeding within half an hour of birth.
- Check if the neonate fits the admission criteria to NCC – Poorly controlled diabetes in mother (as defined above) and/or symptomatic hypoglycaemia.
- Monitor the neonate for any clinical symptoms of hypoglycaemia (eg. jitteriness, lethargy, floppiness, central cyanosis, apnoea, poor feeding, seizures):
  - If no symptoms/signs, perform the first BGL (heel prick using the glucometer) around 2 hours of age and follow the clinical pathway in Appendix A
  - If symptomatic, perform the first BGL (heel prick using the glucometer) immediately and if confirmed (BGL<2.6mmol/L), admit to NCC and follow the clinical pathway in Appendix B

Ongoing Monitoring

- Monitor high risk neonates for at least the first 24 hours of life as per clinical pathway (Appendix A).
- Continue monitoring until the neonate's BGLs remain at safe levels (≥2.6mmol/L) for at least 24 hours after the last episode of hypoglycaemia, as per clinical pathway in Appendix A.
- Determine if the neonate has resistant, recurrent or unexplained hypoglycaemia:
  - Resistant Hypoglycaemia: hypoglycaemia requiring infusions of large amounts of glucose (>12 mg/kg/min) to maintain normal BGLs
  - Recurrent hypoglycaemia: recurrent hypoglycaemia (if persisting beyond the first few days of life)
  - Unexplained hypoglycaemia: hypoglycaemia without recognised predisposing factors such as neonates of diabetic mothers, small or large for gestational age

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HYPOGLYCAEMIA – MONITORING AND MANAGEMENT OF HIGH RISK NEONATES

- In these cases, consult endocrine team at Sydney Children's Hospital urgently and consider the clinical pathway in Appendix C for management. NB. The clinical pathway in Appendix C is only a suggested pathway and may vary based on the underlying aetiology and the response of the neonate.
- Refer to Appendices D and E for a quick guide on the glucose infusion rates and the list of investigations and relevant sampling for resistant or persistent hypoglycaemia.

5. DOCUMENTATION

- eMR
- Medication chart
- Neonatal Observation Chart
- Maternal Diabetes Care Plan

6. EDUCATIONAL NOTES

- Blood glucose concentrations reach a nadir in healthy neonates around 1 to 2 hours after birth and stabilise by 3 to 4 hours. Healthy neonates compensate for "physiologic" hypoglycaemia by producing and using alternative fuels including ketone bodies, lactate and free fatty acids.
- Preterm and small for gestation neonates have limited metabolic capacity for production of these alternative fuels.
- Neonates of diabetic mothers are hyperinsulinaemic which prevents production of alternative fuels.
- A widely used cut-off for neonatal hypoglycaemia is <2.6mmol/L.
- Abnormal brain stem and somato-sensory evoked potentials, and abnormalities in MRI and brain ultrasounds may be demonstrated in some neonates with BGLs below this level. Furthermore, preterm neonates with recurrent BGL readings less than this level were found to have adverse neurodevelopmental outcomes at 18 months of age. These differences in developmental outcomes were no longer discernible when the children were assessed at 8 years of age.
- Portable glucometer test-strip results demonstrate a reasonable correlation with actual plasma glucose concentrations, but the variation from the actual level may be as much as 0.5 to 1.1mmol/L (or 15-20%). This variation is greatest at low glucose concentrations.

7. RELATED POLICIES/PROCEDURES/CLINICAL PRACTICE LOP

- SESLHD Gestational Diabetes Mellitus Management (GDM) Policy (August 2018)
- RHW Obesity and Weight Gain in Pregnancy, Labour and Postpartum LOP (December 2014)

8. RISK RATING

- Medium

9. NATIONAL STANDARD

- Standard 1 Governance for Safety and quality in Health Service Organisation
- Standard 9 Recognising and Responding to Clinical Deterioration in Acute Health Care

10. ABBREVIATIONS AND DEFINITIONS OF TERMS

NCC	Newborn Care Centre	LGA	Large for Gestational Age
SGA	Small for Gestational Age	BGL	Blood Glucose Level

HYPOGLYCAEMIA – MONITORING AND MANAGEMENT OF HIGH RISK NEONATES

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HYPOGLYCAEMIA – MONITORING AND MANAGEMENT OF HIGH RISK NEONATES

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REVISION & APPROVAL HISTORY
August 2018 reviewed and endorsed RHW NCC LOPs Committee
July 2013 Minor amendment
Endorsed Therapeutic & Drug Utilisation Committee 19/2/13 and Maternity Services LOPs February 2013 – replacing *'Postnatal Wad Management of Term Infants at risk of Hypoglycaemia'*
Approved Quality Council 21/2/05
Endorsed Neonatal Clinical Committee 8/2/05

FOR REVIEW: 2021

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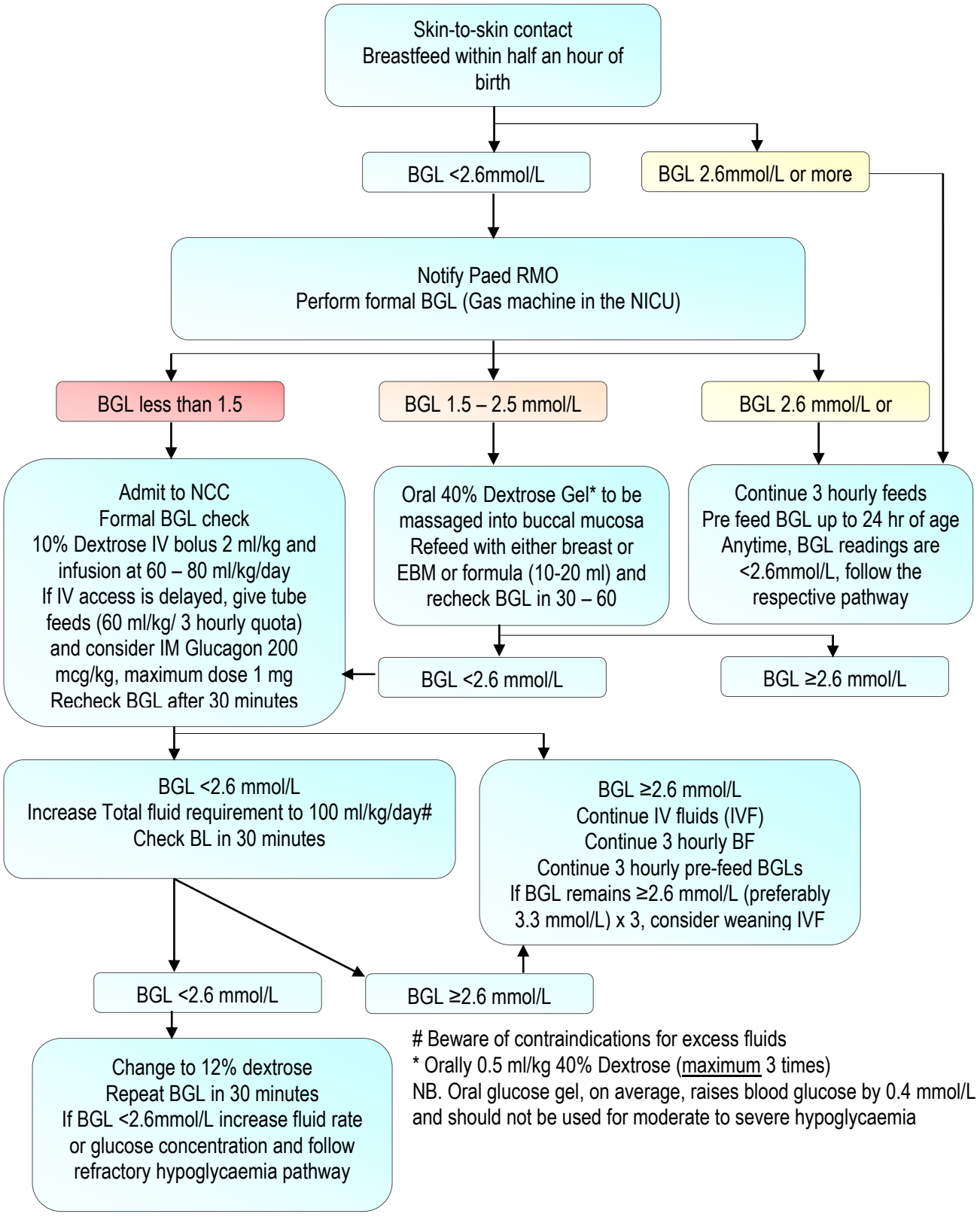
Appendix A

Asymptomatic neonates at risk of Hypoglycaemia
(Maternal diabetes, late preterm 34 – 36+6/40, Term SGA and LGA infants)



Beware of contraindications for excess fluids
* Orally 0.5 ml/kg 40% Dextrose (maximum 3 times)
NB. Oral glucose gel, on average, raises blood glucose by 0.4 mmol/L and should not be used for moderate to severe hypoglycaemia

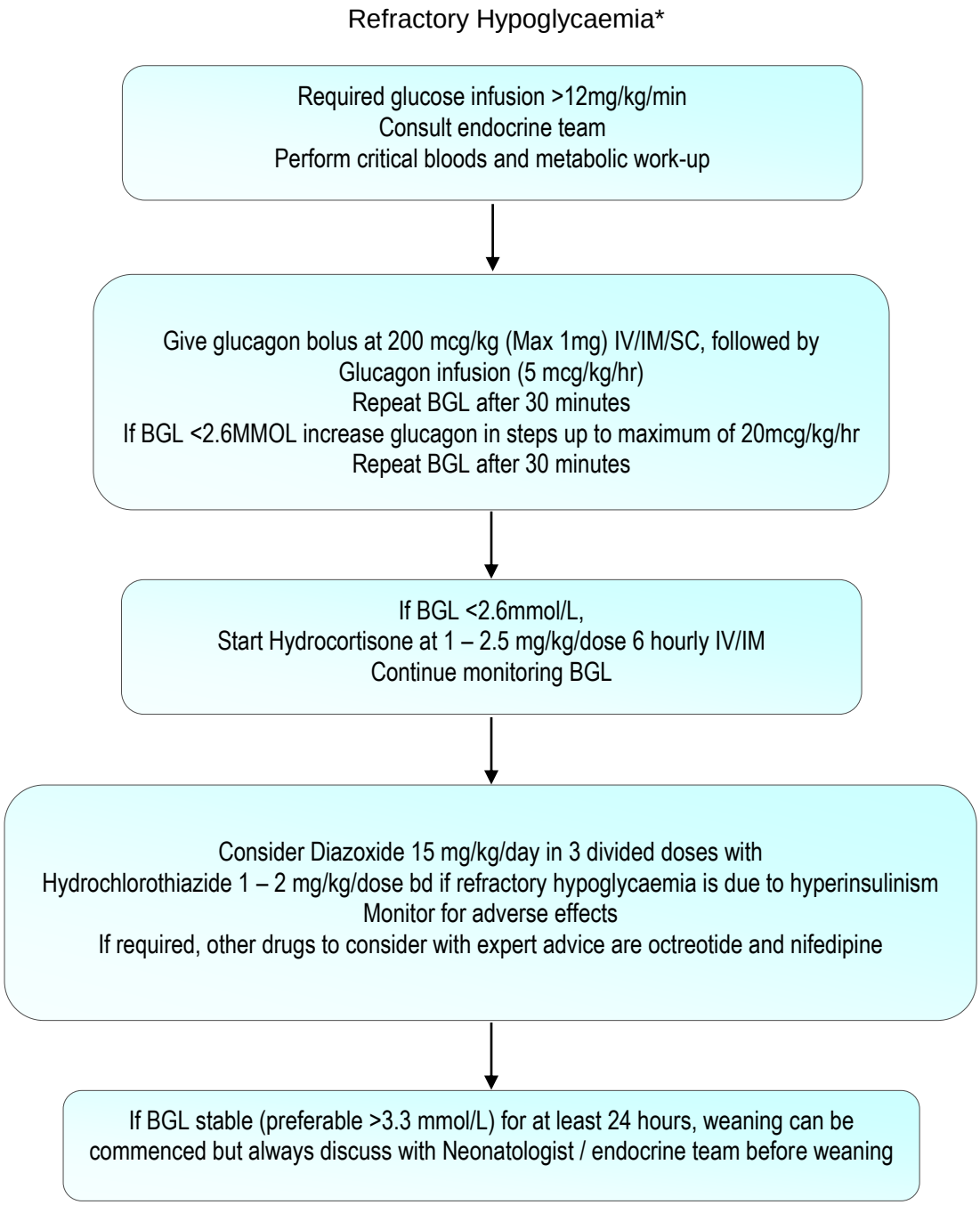
Appendix B

Symptomatic Hypoglycaemia*

Urgently check formal BGL
Administer 40% dextrose if oral solution allowed
Insert cannula, give 10% Dextrose IV bolus at 2ml/kg and commence IV
Dextrose infusion at age appropriate fluid rate
Repeat BGL after 30 minutes

*Symptomatic hypoglycaemia: Defined as symptoms including irritability, tremors, exaggerated Moro reflex, high-pitch cry, seizures, lethargy, floppiness cyanosis, apnoea and poor feeding with a corresponding BGL of <2.6mmol/L

Appendix C



* Refractory Hypoglycaemia is defined as Hypoglycaemia requiring infusions of a large amount of glucose (>12 mg/kg/min) to maintain normoglycaemia

Appendix D

Table: Glucose infusion rate in mg/kg/min by dextrose infusion rate in ml/kg/day with different dextrose strengths

GLUCOSE INFUSION	DEXTROSE STRENGTH WITH INFUSION RATE IN ML/KG/DAY			
mg/kg/min	**10%**	**12.5%**	**15%**	**20%**
5	72	58	48	36
6	86	69	58	43
7	101	81	67	50
8	115	92	77	58
9	130	104	86	65
10	144	115	96	72
11	158	127	106	79
12	173	138	115	86
13	187	150	125	94
14	202	161	134	101
15	216	173	144	108
16	230	184	154	115
17	245	196	163	122
18	259	207	173	130
19	274	219	182	137
20	292	230	192	146

Formula for calculating glucose infusion rate in mg/kg/min

$$\text{Glucose infusion rate (mg/kg/min)} = \frac{\text{Dextrose concentration} \times \text{Vol. infused in ml/kg/day}}{144}$$

Appendix E

List of investigations and relevant sampling for resistant or persistent hypoglycaemia

NO	TEST	AMOUNT	CONTAINER	SAMPLE
A.	**INVESTIGATIONS THAT ARE MORE RELIABLE WHEN THE FORMAL BLOOD GLUCOSE <**			
1	Insulin, Cortisol, and Growth Hormone	1300 uL	Gold	Serum
2	Plasma Ketones #	200 uL	Grey	Plasma
3	Blood Lactate #	300 uL	Grey	Plasma
4	Urine for a metabolic screen to include ketones, amino acids, organic acids and	10 ml	Sterile Yellow Urine Jar	Urine
5	Urine Ketones		Clinistix	
6	Urine for reducing substances*	5 ml	Yellow Urine Jar	Urine
B.	**CONSIDER FURTHER INVESTIGATIONS**			
1	Capillary gas		Capillary tube	Blood
2	Carnitine#	250 uL	Dark Green	Plasma
3	Aspirate aminotransferase (AST)	100 uL	Gold	Serum
4	Alanine aminotransferase (ALT)	100 uL	Gold	Serum
5	Uric acid	200 uL	Gold	Serum
6	Lactic acid#	300 uL	Grey	Plasma
7	Plasma amino acids #	250 uL	Dark Green	Plasma
8	Creatine kinase (CK)	100 uL	Gold	Serum
9	Ammonia#	500 uL	Purple	Plasma
10	Acylcarnitine profile#	250 uL	Dark Green	Blood
11	DNA for MCAD mutation	3 ml	Purple	Blood
	The last two investigations can be done from the neonatal screening blood spots.			
C.	**OTHERS**			
1	Ophthalmic examination			
2	Cranial ultrasound scan and/or MRI (specifically requesting pituitary views)			

Specimens that need to go on ICE
* Specimen needs to send to laboratory within 30 minutes