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Title: **Digoxin for neonates**			Effective date: **18 January 2019**	
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BRIEF ADMINISTRATION GUIDE

(For more detailed guideline information please see the following pages)

Indications:

- Treatment of supraventricular tachycardia, atrial flutter and atrial fibrillation[1-4]
- Treatment of chronic heart failure[1-4]

Route: Intravenous or Oral[1-3]

Dose:

Loading Dose[1,3]
If required, administer IV or oral over 24 hours in 3 divided doses

Intravenous Loading Dose (microgram/kg)				
	0 hours	8 hours	16 hours	Total Load
Pre-term infant	10	5	5	20
Term infant	15	7.5	7.5	30

Oral Loading Dose (microgram/kg)				
	0 hours	8 hours	16 hours	Total Load
Pre-term infant	13	6	6	25
Term infant	15	7.5	7.5	30

Maintenance Dose[1,3]
Administer in 1 to 2 divided doses, beginning 12 hours after the loading dose

	Intravenous	Oral
Pre-term infant	4 microgram/kg	5 microgram/kg
Term infant	8 microgram/kg	10 microgram/kg

Supplied as:

- Digoxin 500 microgram/2 ml vial[6]
- Digoxin 50 microgram/ml oral elixir[1]

Preparation and administration:

Slow IV Injection[5,7,8]

- Dilute 1 ml digoxin (250 microgram) with 9 ml of compatible fluid (sodium chloride 0.9%) to make 10 ml of a 25 microgram/ml solution. To prepare, draw up digoxin in one syringe and add to a second syringe containing the diluent, then mix well Note: Failure to use the two-syringe technique causes drug in the 'dead space' to be drawn up also which can result in a significantly larger dose than intended
- Administer prescribed dose by intravenous infusion over 5 to 20 minutes using the NICU slow infusion procedure. Avoid rapid injection – can cause vasoconstriction leading to hypertension and reduced coronary flow

Oral[2-4]

- Draw up prescribe dose in an oral syringe and administer digoxin at the same time in relation to feeds

Monitoring:

- Monitor potassium, magnesium, calcium and renal function at baseline, and periodically during therapy, correcting any abnormalities[3,7,9]
- Monitor blood pressure, heart rate and rhythm, along with periodic ECGs, before and during therapy[5,7,8,9]
- Therapeutic drug monitoring is required[3,7-9]. Refer to Observations and Management for details
- Monitor for signs of adverse effects and/or toxicity[4,10]
- Ensure proper needle or catheter placement prior to and during administration to avoid extravasation[5,8]

1. Purpose and scope

To facilitate the safe and effective use of digoxin in the neonatal intensive care unit (NICU).

2. Drug

Drug	Digoxin
Drug action	Digoxin is a cardiac glycoside that increases the force of myocardial contraction resulting in improved cardiac output (positive inotropic action) and reduces conductivity within the atrioventricular (AV) node resulting in a decreased heart rate (negative chronotropic action)[1-3]
Indications	• Treatment of supraventricular tachycardia, atrial flutter and atrial fibrillation[1-4] • Treatment of chronic heart failure[1-4]
Presentation	Digoxin 500 microgram/2 ml vial[6] Clear, colourless solution. Excipients include propylene glycol, alcohol, buffered with sodium phosphate and citric acid[5] Digoxin 50 microgram/ml oral elixir[1] Clear, yellow, lime flavoured solution in a sweetened, aqueous-alcoholic vehicle[4]
Route	Intravenous or Oral[1-3]
Dose	**Loading Dose[1,3]** If required, administer loading dose IV or oral over 24 hours in 3 divided doses **Intravenous Loading Dose (microgram/kg)** 0 hours / 8 hours / 16 hours / Total Load Pre-term infant: 10 / 5 / 5 / 20 Term infant: 15 / 7.5 / 7.5 / 30 **Oral Loading Dose (microgram/kg)** 0 hours / 8 hours / 16 hours / Total Load Pre-term infant: 13 / 6 / 6 / 25 Term infant: 15 / 7.5 / 7.5 / 30 Note: Do not administer a loading dose if a patient has taken cardiac glycosides within the last 2 weeks[5] **Maintenance Dose[1,3]** Administer maintenance dose in 1 to 2 divided doses, beginning 12 hours after completion of the loading dose **Intravenous** / **Oral** Pre-term infant: 4 microgram/kg / 5 microgram/kg Term infant: 8 microgram/kg / 10 microgram/kg
Contraindications	• Hypersensitivity to digoxin, other forms of digitalis, or any component of the formulation[2-4,7,9,10] • Ventricular tachycardia or fibrillation[1-4,7,9,10] • Complete heart block[1,4,9,10]

Precautions	• Pre-term infants, especially extreme immaturity[2,3,9,10] • Electrolyte disturbances including hypokalemia, hypomagnesemia, hypercalcemia[1-4,7,9] • Renal impairment[2,3,7,9,10] • Heart failure with preserved left ventricular systolic function including hypertrophic cardiomyopathy, constrictive pericarditis, amyloid heart disease, and acute cor pulmonale[1-4,7] • Sinus node disease, partial heart block, [1-4,7,9] • Wolff-Parkinson-White syndrome[1-4,7,9] • Myocarditis[1-4,9,10] • Severe respiratory disease[1,4,9] • Thyroid disease (manage underlying disorder first)[1,3,4,7,9] • Avoid rapid intravenous administration (risk of hypertension and reduced coronary flow)[1] • Intravenous digoxin contains propylene glycol which is potentially toxic in large quantities[3] • Concurrent use of medications which affect renal function e.g. ACE inhibitor, NSAIDS, COX-2 inhibitors may increase digoxin exposure[2]
Incompatibilities	• Compatible with water for injection, sodium chloride 0.9%, glucose 5%, Lactated Ringer's (Hartmann's)[5,8] • The maximum dilution for digoxin is 50 microgram/ml (higher concentrations may lead to precipitation)[2,5,8] • Do not mix digoxin with any other medications in the same solution or administering via the same IV line. Consult a pharmacist for specific drug compatibility[5] • Medications which predispose to hypokalaemia include corticosteroids, diuretics, amphotericin, salbutamol[4,6] • Medications which increase digoxin levels include amiodarone, flecainide, spironolactone, erythromycin, gentamicin, indomethacin[4,6] • Medications which reduce digoxin levels include antacids, metoclopramide, adrenaline, salbutamol, phenytoin[4,6] • Effect of digoxin may be increased by intravenous calcium potentially resulting in life-threatening arrhythmias. Avoid if possible or administer intravenous calcium slowly or in small amounts[4,6]
Adverse effects	• Nausea, vomiting, diarrhoea[1,2,4,10] • Lethargy[2,10] • Arrhythmias, conduction disturbances[1,2,4,7] • Dizziness, blurred or yellow vision[1,4] • Rash, eosinophilia[1,3,4]

3. Administration

Competency for administration	This procedure is carried out by, or under, the direct supervision of a registered nurse/registered midwife who holds current Waikato DHB Generic Medicine Management and IV certification as well as Neonatal specific competency NCV/NAC.

Preparation & Administration	**Slow IV Injection**[5,7,8] • Prepare immediately before use. • Dilute 1 ml digoxin (250 microgram) with 9 ml of compatible fluid (sodium chloride 0.9%) to make 10 ml of a 25 microgram/ml solution. To prepare, draw up digoxin in one syringe and add to a second syringe containing the diluent, then mix well. Note: Failure to use the two-syringe technique causes drug in the 'dead space' to be drawn up also which can result in a significantly larger dose than intended. • Administer prescribed dose by intravenous infusion over 5 to 20 minutes. Avoid rapid injection – can cause vasoconstriction leading to hypertension and reduced coronary flow. • Discard any unused portion of the vial remaining. **Oral**[2-4] • Draw up prescribe dose in an oral syringe • Administer digoxin at the same time in relation to feeds
Observations and management	• Monitor potassium, magnesium, calcium and renal function at baseline, and periodically during therapy, correcting any abnormalities[3,7,9] • Monitor blood pressure, heart rate and rhythm, along with periodic ECGs, before and during therapy to assess desired effects and potential toxicity[5,7-9] • Therapeutic drug monitoring is required. Monitor serum digoxin levels 12 to 24 hours after the loading dose and then at clinically appropriate intervals. Preferably take blood samples immediately before a dose (`trough'), otherwise at least 8 hours after dose. Serum therapeutic range: 0.6-2.5 nanomol/L. Toxic levels are 1.5 – 2 times the upper therapeutic range[3,7-9]. • Monitor for signs of adverse effects and/or toxicity[4,10]. • Ensure proper needle or catheter placement prior to and during administration – avoid extravasation as may cause severe complications (vesicant)[5,8]
Special considerations (audit, funding, storage)	• Digoxin vials and oral elixir are unregistered medicines available under section 29. Names of the patient and prescriber must be sent to Pharmacy when ordering. • Vials should be stored at room temperature (below 25°C) and protected from light[5]. • Diluted solutions for IV administration should be prepared immediately before use, however are stable at room temperature for up to 6 hours[5]. • Digoxin oral liquid must be stored at room temperature (below 25°C) and protected from light[4]. • The pH of digoxin is 6.8 to 7.2[5].
Rescue medication	Management of digoxin toxicity includes[2,10,11]: • Withhold and review digoxin dose or case treatment • Correct any electrolyte abnormalities • Treat arrhythmias • Consider use of digoxin-specific antibody fragment F(ab)

4. Associated Documents

- Waikato DHB. Administration of a slow infusion/intermittent infusion in Newborn Intensive Care Unit (NICU) Procedure 4360.

5. References

1. New Zealand Formulary for Children (NZFC). 2018. Digoxin. Accessed 30th August 2018. Available from: https://www.nzfchildren.org.nz/nzf_982
2. Truven Health Analytics Inc. Pediatrics and Neofax®. 2018. Digoxin monograph. Accessed 30th August 2018. Available from: http://www.micromedexsolutions.com.
3. Lexicomp. Digoxin: Pediatric drug information monograph. Uptodate. Accessed 30th August 2018. Available from: https://www.uptodate.com.
4. Pharmacy Retailing (NZ) Limited. Lanoxin Paediatric Elixir. 13 July 2015. Available from: http://www.medsafe.govt.nz/profs/datasheet/l/Lanoxintabelixinj.pdf
5. New Zealand Hospital Pharmacists Assoc. Inc. Notes on Injectable Drugs 7th ed, 2015.
6. New Zealand Formulary. 2018. Accessed 30th August 2018. Available from: https://www.nzf.org.nz/nzf_1
7. Phelps SJ, Hagemann TM, Lee KR, Thompson AJ. The Teddy Bear Book: Pediatric Injectable Drugs. 10th edition. American Society of Health-System Pharmacists; 2013.
8. The Royal Children's Hospital Melbourne. Paediatric Injectable Guidelines. Accessed 30th August 2018. Available from: https://pig.rch.org.au.
9. Canterbury DHB Neonatal Services. Digoxin Drug Information Sheet. November 2012. Available from: http://www.cdhb.health.nz/Hospitals-Services/Health-Professionals/Neonatal-Clinical-Resources/Neonatal-Drug-Information-Sheets.
10. Auckland DHB Newborn Services. Digoxin hydrochloride Drug Protocol. September 1998. Available from: http://www.adhb.govt.nz/newborn/DrugProtocols
11. New Zealand Formulary for Children (NZFC). 2018. Cardiac glycosides. Accessed 30th August 2018. Available from: https://www.nzfchildren.org.nz/nzf_981