East Midlands Congenital Heart Centre

University Hospitals of Leicester NHS
NHS Trust

Paediatric Cardiology

Digoxin Dosing and Monitoring in Children Guideline

Staff relevant to:	Medical & Nursing staff working within EMCHC
Written by: Reviewed by:	Dr R Gupta, Dr Shebani Vicky Worthy (Pharmacist), Dr S Shebani
Approval date:	September 2024
Revision Date	March 2026
Trust Ref:	C50/2024
Version	1

Contents

1. Introduction and Who Guideline applies to:

Digoxin is a well-known cardiac glycoside and one of the oldest drugs used today in cardiovascular medicine. It is derived from the foxglove plant. If introduced it requires careful monitoring as it can reach toxic levels with seemingly small doses especially if loading is used which we do not recommend.

Mechanism of action:

Digoxin activates the sodium-potassium ATPase pump in the cardiac myocytes. This causes a build-up of sodium inside the cells which in turn activates the sodium-calcium exchanger. Overall, there is an accumulation of calcium in the myocytes which increases their contractility. It also slows the conduction by stimulating the vagus nerve and inhibiting the conduction through SA and AV node.

Indication: As recommended in ISHLT 2014 guidelines, SVR trial, AHA 2024

(1) Pharmacologic treatment of chronic HF, reduced EF (systolic HF) (ISHLT 2014)

a. Digoxin is not recommended for children with asymptomatic LV dysfunction because no survival benefit was seen with digoxin in adults with HF and low EF. Class I, Level of Evidence C
b. Digoxin may be used to relief symptoms in children with symptomatic HF and low EF. Class IIa, Level of Evidence C

(2) Pharmacologic treatment of preserved EF (diastolic heart failure) (ISHLT 2014)

a. Use of digoxin is not recommended for treatment of HFpEF in children, unless there is an additional indication such as arrhythmia requiring atrial rate control. Level of Evidence C

(3) Single ventricle patients with no history of arrhythmias between Stage 1 and Stage 2 palliation.

a. These patients had myocardial dysfunction as the indication of digoxin and lower mortality as per post analysis of SVR trial.

(4) Focal atrial tachycardia (EHRA, APEC 2013 consensus statement)

a. Digoxin is recommended as the first-line therapy, adding a Class IC drug in case of failure, and using amiodarone as a second- or third-line drug.

2. Guideline Standards and Procedures

2.1 Dose:

Dose ranges are variable in different studies and BNFc. Usual practice at EMCHC is to start digoxin @ 3 microgram/kg/dose twice a day.

Monitoring of digoxin levels is done after 7 days of initiation of therapy, aiming for a range of 0.5-0.9 microgram/litre. Dose may need further adjustment depending on drug levels and other factors affecting it. Manufacturer recommends decreasing the dose of digoxin whilst on amiodarone.

Loading dose is not recommended in paediatric patients.

2.2 Side Effects (BNFc)

It is important to acknowledge that digoxin has a narrow therapeutic index and might reach toxic blood levels unexpectedly.

Common: ECG changes like bradycardia, prolongation of PR interval, ST-T changes, various types of arrhythmias, cardiac conduction problems, cerebral impairment, nausea, vomiting, diarrhoea, skin reactions, vision disorders, eosinophilia

Uncommon/Rare: Decreased appetite, asthenia, malaise, confusion, psychosis, headache, thrombocytopenia

2.3 Monitoring:

Blood levels of digoxin: A steady state of digoxin is attained after 7 days of initiation of therapy. Blood samples for digoxin levels are taken after 6 hours of dose administration as the distribution of digoxin to various tissues takes several hours. Therapeutic digoxin levels as per various studies are in the range of 0.5-0.9 microgram/litre. Toxicity could be increased by dyselectrolytemia and/or renal dysfunction and concomitant use of other antiarrhythmics like amiodarone. The clinical effect of digoxin is potentiated by amiodarone, diltiazem, flecainide, quinidine, quinine and verapamil and the maintenance dose should be halved if any of these drugs are introduced.

1. Erythromycin, omeprazole and tetracycline may also cause blood levels of digoxin to double in approximately 10% of patients and this effect may last for several months after discontinuation of the aforementioned drugs.
2. **ECG:** Perform an ECG with every dose change of digoxin, watch for prolonged PR interval, biphasic P waves, variable degree of heart block, ST segment changes, ventricular arrhythmias, ectopics
3. **Regular checks of dose amount with update of drug charts:** to be calculated by Cardiology team

2.4 Interpreting digoxin levels, adjusting dosage, and antidote:

- Digoxin levels in the body have a linear relationship with dosages. According to various references, the equation for this relationship is given by:
  New Digoxin Dose =(Desired Concentration Level/Current concentration level)×Old Digoxin Dose
- Patient may be on other medications which could possibly affect the digoxin levels in blood.
- If the levels are very low, the usual guidance is to increase by 10-15%.
- **If serum levels are >2.2 or signs of toxicity: Withhold dose immediately and** discuss with on call Cardiology Registrar. Random daily serum levels to be done until levels are around 1 microgram/litre, following which digoxin reintroduction could be considered. If you are a healthcare professional with an enquiry please visit:
- **www.TOXBASE.org** or contact **UHL pharmacy.**
- Checking blood levels is also recommended with every dose change after 7 days of administration.

2.5 Dose reduction: Recommended in the following scenarios:

- Risk of digitalis toxicity increases with hypercalcemia, hypokalemia, hypomagnesemia, hypoxia, recent myocardial infarction, severe respiratory disease, thyroid disease, sick sinus syndrome, premature infants with impaired renal clearance. Use with caution is advised in these scenarios and these patients will need electrolyte and digoxin level monitoring.
- Renal dysfunction
- Acute phase of myocarditis
- Co-administration with drugs inhibiting AV conduction (beta-blockers, amiodarone, verapamil, diltiazem).
- **Digoxin levels to be discussed with Paediatric Cardiology on-call Registrar/Consultant for advice on continuation of therapy.**

2.6 Contraindications:

- HCM
- Antidromic tachycardia through accessory bypass tracts in Wolff-Parkinson-White syndrome
- High-grade AV block.

2.7 Preparations/Medicinal forms:

1. Oral solution 50 micrograms/ml
2. Tablets: 62.5/125/250 micrograms per tablet

3. Education and Training

Medical staff to check the dosage on regular basis to avoid errors

4. Monitoring Compliance

Monitor any incidents of Digoxin drug errors

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Digoxin blood levels, ECG changes	Drug errors and incident forms	Vicky Worthy	3 Monthly	Email notifications

5. Supporting References:

1. The International Society for Heart and Lung Transplantation Guidelines for the management of pediatric heart failure: Executive summary. The Journal of Heart and Lung Transplantation, Vol 33, No 9, September 2014
2. Evaluation and Management of Chronic Heart Failure in Children and Adolescents With Congenital Heart Disease: A Scientific Statement From the American Heart Association. AHA scientific statement, Circulation, 2024;149.
3. Association of Digoxin With Interstage Mortality: Results From the Pediatric Heart Network Single Ventricle Reconstruction Trial Public Use Dataset. Oster et al. J Am Heart Assoc. 2016 Jan; 5(1): e002566. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4859374/
4. Pharmacological and non-pharmacological therapy for arrhythmias in the pediatric population: EHRA and AEPC-Arrhythmia Working Group joint consensus statement. Europace (2013) 15, 1337–1382

5. Key Words:

Digoxin, levels, toxicity, children's cardiology

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title): Dr S Shebani Paediatric Cardiologist	**Executive Lead:** Chief Medical Officer
REVIEW RECORD	
Description Of Changes (If Any)	