Digoxin

2019

Newborn use only

Alert	Digoxin has a narrow therapeutic index, check the dose carefully. Lanoxin adult injection is 10 times more concentrated than Lanoxin infant injection. Check product selection carefully. Rapid IV injection may cause hypertension and reduced coronary flow. Lanoxin Paediatric Elixir contains ethanol of approximately 84 mg/mL, equivalent to 10.6% absolute volume. The long-term effects of prolonged exposure to ethanol content from medicines have not been studied.
Indication	Supraventricular tachycardia [atrioventricular reciprocating tachycardia or atrioventricular nodal re-entrant tachycardia, excluding Wolff-Parkinson-White] Atrial fibrillation and atrial flutter Heart failure [add-on treatment in infants with reduced ejection fraction if not otherwise contraindicated].
Action	Slows heart rate and reduces AV nodal conduction by an increase in vagal tone and a reduction in sympathetic activity. A Na^+/K^+-ATPase inhibitor which increases the force of myocardial contraction by increasing the release and availability of stored intracellular calcium.
Drug Type	Cardiac glycoside
Trade Name	Lanoxin PG, Sigmaxin-PG, Lanoxin, Sigmaxin, Lanoxin Paediatric Elixir, Lanoxin Infant injection, Lanoxin injection
Presentation	**ORAL:** Lanoxin PG, Sigmaxin-PG tablet 62.5microgram Lanoxin, Sigmaxin, tablet 250 microgram (scored) Lanoxin Paediatric Elixir oral liquid 50 microgram/mL (contains propylene glycol: approximately 52 mg/mL and ethanol: Approximately: 84 mg/mL, equivalent to 10.6% absolute volume) **INTRAVENOUS:** Lanoxin Infant injection 50 microgram/2mL Lanoxin inj (500 microgrm/2mL) CAUTION: CONCENTRATED product Both contain ethanol, propylene glycol, citric acid and sodium phosphate.
Dosage/Interval	**Term neonate (37^{+0} weeks and over)** PO: Loading dose of 10 microgram/kg/dose 8-hourly for 3 doses, followed by Maintenance dose of 8 microgram/kg/dose daily (may increase up to 12 microgram/kg/day according to therapeutic drug monitoring and in consultation with cardiologist) IV: Loading and maintenance doses are 75% of oral dose. **Preterm neonate:** PO: Loading dose of 10 microgram/kg/dose 8-hourly for 3 doses, followed by Maintenance dose of **5–7.5** microgram/kg/dose daily (up to 12 microgram/kg/day according to therapeutic monitoring and in consultation with cardiologist) IV: Loading and maintenance doses are 75% of oral dose. **Infants aged 2–24 months:** PO: Loading dose 10 microgram/kg/dose 8-hourly for 2–3 doses, followed by Maintenance dose: 8–10 microgram/kg/dose daily or in 2 divided doses. IV: Loading and maintenance doses are 75% of oral dose. Doses should be titrated to the lowest dose needed to achieve effect. **Renal impairment:** Predominantly renally cleared (about 70%); reduce dose by at least half in renal impairment. When switching from oral to IV therapy, reduce the digoxin dosage by 20–25%.
Maximum daily dose	250 microgram daily.

Route	Oral Intravenous
Preparation/Dilution	IV **CHECK PRODUCT SELECTION CAREFULLY. Dilution only applies to Lanoxin Infant Injection.** Lanoxin Infant Injection: Add 2 mL (50 microgram) of digoxin to 8 mL of sodium chloride 0.9% or glucose 5% to make a 5 microgram/mL solution.
Administration	ORAL: May be taken with or without food.[32] However, administer consistently at the same time with respect to meals to avoid day to day variation.[33] IV: Give over at least 10 minutes. IM: Do not give IM (unpredictable absorption, local irritation).
Monitoring	Check renal function and electrolyte concentrations before starting digoxin. For intravenous infusion, continuous cardiac monitoring is recommended. It may not be necessary when IV injection is used to temporarily replace oral dosing in a patient stabilised on digoxin. Check local guidelines. The onset of effect is approximately 5 to 10 minutes, with a maximum effect being achieved after 2 hours. Take drug levels at least 6 hours after the dose is given. For oral treatment without loading dose, steady state is reached after about 7 days if renal function is normal (half-life is 36 hours); this may be prolonged in renal impairment. The therapeutic range for those with atrial tachyarrhythmias is 0.5 to 2 microgram/L (0.6 to 2.6 nmol/L) as toxicity is more common at digoxin concentrations >2 microgram/L. However, toxic effects can occur at lower concentrations, particularly in the elderly or in those with electrolyte disturbance, hypoxia or hypothyroidism. GI symptoms (e.g. nausea, anorexia) may precede cardiac symptoms (e.g. arrhythmias). Heart failure: Consider maintaining lower concentrations of 0.5 to 0.8 microgram/L (0.6 to 1 nmol/L) in patients with heart failure who are in sinus rhythm. Therapeutic drug monitoring for digoxin should be performed using an assay free from interference with digoxin-like immunoreactive factors, spironolactone, canrenoate, digoxin metabolites and steroids.
Contraindication	Contraindicated in second‑ or third-degree heart block (without pacemaker), SVT involving accessory pathway (Wolff-Parkinson-White syndrome), ventricular tachycardia and ventricular fibrillation, hypertrophic obstructive cardiomyopathy, cor pulmonale (acute and chronic) or constrictive pericarditis.
Precautions	In acute myocardial infarction, ischaemic heart disease or myocarditis, digoxin increases risk of arrhythmias. Use digoxin cautiously in sick sinus syndrome (risk of severe bradycardia or sinoatrial block). Digoxin may worsen cardiac function in severe aortic stenosis because it increases the force of myocardial contraction. Digoxin increases risk of arrhythmias after DC cardioversion; withhold digoxin for 1–2 days before cardioversion or use lowest effective energy. Hyperthyroidism—may decrease digoxin concentration and increase sympathetic tone; monitor digoxin concentration and alter dose when required or combine with another agent; dosage adjustment may be required when condition is corrected. Hypothyroidism—may increase digoxin concentration; monitor digoxin concentration and alter dose as required; dosage adjustment may be required when condition is corrected. Hypokalaemia, hypomagnesaemia, hypercalcaemia, acidosis, hypoxia—may increase sensitivity to digoxin (especially hypokalaemia); symptoms of toxicity may occur at lower digoxin concentrations.
Drug Interactions	Treatment with drugs that slow cardiac conduction, cause bradycardia or arrhythmias may potentiate the cardiac adverse effects of digoxin; use combinations carefully and monitor cardiac function.

	Treatment with drugs that inhibit or induce P-glycoprotein (ABCB1) may increase the risk of adverse effects or decrease digoxin's efficacy. Use of beta blockers and digoxin increases risk of bradycardia and AV block - additive effect. Use of digoxin and amiodarone increases risk of dysrhythmias and torsade de pointes as amiodarone blocks P-glycoprotein (ABCB1). Torsade de pointes might by facilitated by bradycardia caused by digoxin. Use of digoxin and azoles, clarithromycin and some HIV-protease inhibitors increases risk of dysrhythmias by inhibition of P-glycoprotein (ABCB1). Use of digoxin and non-dihydropyridine calcium channel blockers increases risk of bradycardia, asystole and sinus arrest by inhibition of P-glycoprotein (ABCB1) and their synergistic effect on the heart. Use of digoxin and loop or thiazide diuretics, amphotericin B, corticosteroids increase risk of dysrhythmias as hypokalaemia potentiates digoxin toxicity. Use of digoxin and IV calcium increases risk of dysrhythmias as hypercalcemia increases effect of cardiac glycosides. Use of digoxin and propafenone increases risk of dysrhythmia probably by inhibition of P-glycoprotein (ABCB1) by propafenone. P-glycoprotein (ABCB1)-inducers: Carbamazepine; phenytoin; rifampicin; St John's wort; tipranavir. P-glycoprotein (ABCB1)-inhibitors: Amiodarone, azithromycin, carvedilol, ciclosporin, clarithromycin, cobicistat, daclatasvir, erythromycin, everolimus, glecaprevir with pibrentasvir, isavuconazole, itraconazole, ketoconazole, lapatinib, ledipasvir, ritonavir, ticagrelor, tolvaptan, vandetanib, velpatasvir, vemurafenib, venetoclax, verapamil.
Adverse Reactions	Digoxin may worsen arrhythmias (proarrhythmic effect). Digoxin has a narrow therapeutic range; adverse effects are related to its plasma concentration and very few occur at <0.8 microgram/L (1 nmol/L). Digoxin usually has an effect on the ECG and may result in prolonged PR interval, ST depression or T wave inversion (these changes do not necessarily indicate digoxin toxicity or myocardial ischaemia). In children, arrhythmias (including sinus bradycardia) are the earliest and most frequent indicators that digoxin dosage is too high. Common (>1%): Anorexia, nausea, vomiting, diarrhoea, visual disturbances (e.g. blurred vision), drowsiness, dizziness, headache, rash, bradycardia, arrhythmia Infrequent (0.1–1%): Depression, shortened QRS complex, atrial or ventricular extrasystoles, paroxysmal atrial tachycardia with AV block, ventricular tachycardia or fibrillation, heart block. Rare (<0.1%): Thrombocytopenia, seizures, confusion, psychosis, gynaecomastia (long-term use).
Compatibility	Fluids: Glucose 5%, Hartmann's, sodium chloride 0.9%. Y-site: Anidulafungin, bivalirudin, ceftaroline fosamil, ceftobiprole medocaril, ciprofloxacin, cisatracurium, dexmedetomidine, heparin sodium, hydrocortisone sodium succinate, levosimendan, linezolid, midazolam, milrinone, morphine sulfate, pethidine, potassium chloride, remifentanil
Incompatibility	Fluids: No information Drugs: Adrenaline (epinephrine), amiodarone, caspofungin, fluconazole, foscarnet, pentamidine, propofol
Stability	Infusion solution: Stable for up to 6 hours at 25° C.
Storage	Ampoule and oral elixir: Store below 25° C. Protect from light.
Special Comments	Bioavailability of oral dose 60 to 85%. Half-life in infants 18 to 25 hours. 50 to 70% excreted in urine unchanged. Minimally metabolised by hepatic and intestinal enzymes to active and inactive metabolites. Onset of effect occurs 0.5–2 hours after initial oral dose of 500–750 micrograms and 5–30 minutes after initial IV dose of 400–600 micrograms; maximal effect occurs after 1–4 hours (IV) or 2–6 hours (oral).

	Regularly assess patients for digoxin toxicity (including resting heart rate); routine measurement of pulse rate before giving next dose of digoxin is not necessary Assume that any arrhythmia that occurs in a child taking digoxin is due to the drug until proven otherwise. DigiFab (digoxin immune Fab) is available for the treatment of life-threatening overdoses of digoxin: • Dose initially with one vial (40 mg diluted in 4 mL of water for injections) and repeat if symptoms persist or recur. • Full neutralisation dose of DigiFab is: Number of vials = serum digoxin concentration (nanogram/mL) x weight (kg) / 100 (rounded up to nearest vial). However, this is rarely indicated.
Evidence summary	Refer to full version.
References	Refer to full version.

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