ENOXAPARIN

Newborn use only

2021

Alert	Enoxaparin is one type of low molecular weight heparin (LMWH). Commonly known as Clexane. High risk medication. An overdose can be fatal. Treatment must be discussed with the Haematologist on-call before commencement. LMWH is not a suitable choice of anticoagulant in patients with significant bleeding risk (unfractionated heparin (UFH) is preferred), who are clinically unstable or about to have invasive procedures. This is due to longer half-life than UFH and only partial reversal with protamine. Monitoring is performed with anti-factor Xa levels. The APTT is not useful in monitoring LMWH therapy. Please check with your local pathology department on what time of the day/night anti-factor Xa sample processing is performed.
Indication	Prophylaxis of thromboembolic disorder. (Note: Enoxaparin/heparin does not treat the clot that has already occurred but rather its role is to prevent clot extension, i.e. secondary prophylaxis)
Action	It binds to and potentiates anti-thrombin III activity leading to irreversible inactivation of factor Xa, and to a lesser degree inactivation of factor IIa; in turn, inhibiting thrombin and fibrinogen generation.
Drug type	Antithrombotic agent/ anticoagulant; LMWH
Trade name	Clexane, Clexane Forte
Presentation	Clexane (enoxaparin sodium) prefilled syringes, with/out automatic safety lock system, solution for injection*: 20 mg/0.2mL 40 mg/0.4mL 60 mg/0.6mL 80 mg/0.8mL 100 mg/1mL *containing 10 000 anti-Xa unit/mL Clexane Forte, with/out automatic safety lock system, solution for injection$^{\Delta}$: 120mg/0.8mL 150mg/1mL $^{\Delta}$ containing 15 000 anti-Xa unit/mL Enoxaparin injections for patient specific doses can be aseptically prepared by local pharmacy.
Dose	Subcutaneous (SC) injection:[1]

	<2 months of age	**≥2 months**
Prophylactic dose	0.75 mg/kg/dose 12 hourly	0.5 mg/kg/dose 12 hourly

	<2 months of age	**≥2 months**
Treatment dose	1.5 mg/kg/dose 12 hourly	1 mg/kg/dose 12 hourly

Subsequent dose titration is as per anti-Xa levels. The first anti-Xa measurement is usually done after 3 to 4 doses, i.e. around 48 hours after the commencement.
Target peak anti-Xa range: 0.5 to 1.0 units/mL to be measured 4 hours (3-5 hours) after the last subcutaneous injection.[1] Refer to dose adjustment below:[8]

Anti-factor Xa concentration unit/mL	**Dose adjustment**	**Next anti-factor Xa measurement**
<0.35	increase next dose by 25%	4 hr following dose adjustment
0.35 - 0.49	increase next dose by 10%	4 hr following dose adjustment

	0.5 - 1.0	no change	Weekly 4 hr following a dose If change in renal function, addition of antibiotics, signs of bleeding, check level 4 hr after next dose.
	1.1-1.5	decrease next dose by 20%	Before next dose and 4 h following dose adjustment
	1.6 to 2.0	hold dose until anti-factor Xa level <1 then decrease next dose by 30%	4 hr following dose adjustment
	>2.0	hold dose until anti-factor Xa level <0.5 then decrease next dose by 40%	12 h until anti-factor Xa level <0.5, then 4 hr following reinstitution of therapy

Dose adjustment	Therapeutic hypothermia - Enoxaparin is not the preferred anticoagulant. Renal impairment – Monitor anti-Xa factor closely. Dose adjustment is required in severe renal impairment. Discuss with haematologist. Hepatic impairment – Dose adjustment is not established.
Maximum dose	
Total cumulative dose	
Route	Subcutaneous injection.
Preparation	Enoxaparin injections for patient specific administration can be aseptically prepared by local pharmacy as follows: Draw 0.8 mL of sodium chloride 0.9% into a 2 mL syringe. Inject the contents of enoxaparin 20 mg/0.2 mL pre-filled syringe into the sodium chloride syringe to make a final volume of 1 mL. The resulting solution contains 20 mg/mL.

Dose	1.5 mg	2 mg	3 mg	4 mg	5 mg
Volume	0.075 mL	0.1 mL	0.15 mL	0.2 mL	0.25 mL

	Discard remaining solution.
Administration	Administer subcutaneously. Do not remove the air bubble in the prefilled syringe. Rotate the site of subcutaneous injection. Enoxaparin may also be administered via an Insuflon catheter placed into the subcutaneous tissue. However, Insuflon catheters are not recommended for infants less than 3kg. When administering enoxaparin via an Insuflon catheter, the air bubble in the syringe should be removed. Do not rub the injection site after administration. Note: Injection in low birth weight infants with little subcutaneous fat may enter intramuscular rather than subcutaneous which can impact anti-Xa level due to different absorption rate and pharmacokinetics. Significant tissue oedema at injection sites may also impact absorption.
Monitoring	Anti-factor Xa levels Platelet count every 2-3 days Potassium levels Renal function
Contraindications	Hypersensitivity to enoxaparin, heparin or other low molecular weight heparins Active uncontrollable bleeding Severe thrombocytopenia (MIMS) Haemorrhagic stroke Acute bacterial endocarditis (MIMS) History of heparin-induced thrombocytopenia (HIT) within the past 100 days (MIMS)
Precautions	Risk of haemorrhage – example, acquired or congenital bleeding disorders Concomitant medical conditions: Hepatic insufficiency, uncontrolled hypertension, a history of gastrointestinal ulceration, recent neuro- or ophthalmologic surgery and haemorrhage. Heparin-induced thrombocytopenia (HIT)

	Spinal anaesthesia
Drug interactions	Drugs affecting haemostasis should be discontinued prior to enoxaparin therapy unless strictly indicated: Anticoagulants, thrombolytics, non-steroidal anti-inflammatory agents, aspirin, antiplatelet agents or systemic glucocorticoids. If the combination is indicated, enoxaparin should be used with careful clinical and laboratory monitoring of the haemostatic factors, when appropriate. Drugs that increase serum potassium levels may be administered concurrently with enoxaparin sodium under careful clinical and laboratory monitoring.
Adverse reactions	Elevated liver enzymes, anaemia, diarrhoea, peripheral oedema, fever, allergic reaction, urticarial, bruising/ pain at injection site, bleeding, hyperkalaemia Rare: Thrombocytopenia, hyperkalaemia, cholestasis, bullous dermatitis, osteoporosis, allergic reaction
Compatibility	Glucose 5%, sodium chloride 0.9%
Incompatibility	No information available
Stability	Discard any unused contents of syringes. Aseptically prepared product by local pharmacy is stored refrigerated at 2-8°C with an expiry date of 7 days.
Storage	Store below 25°C. Do not freeze. Aseptically prepared product by local pharmacy is stored refrigerated at 2-8°C.
Excipients	Water for injections
Special comments	Protamine may be used to reverse anticoagulant effect of enoxaparin but the reversal is partial.
Evidence	**Efficacy** A review of published reports between 1980 and 2007 comprising of 240 neonates from 13 studies showed that the mean enoxaparin dose that resulted in therapeutic plasma anti-factor Xa levels of 0.5-1.0 units/mL varied between 1.48 and 2.27 mg/kg subcut every 12 hours for all infants. The mean length of therapy for neonatal thrombosis fluctuated from 12 days to 3 months.[5] Higher doses in preterm neonates have been suggested to maintain therapeutic anti-Xa levels.[6,7] However, clinical trials have not been performed to confirm the safety and efficacy of a higher-dose approach. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines 2012 recommend a prophylactic dose of 0.75 mg/kg/dose subcut every 12 hours and 0.5 mg/kg/dose subcut every 12 hours for infants <2 months and ≥2 months respectively. For treatment, doses of 1.5 mg/kg/dose subcut every 12 hours and 1 mg/kg/dose subcut every 12 hours are recommended for <2 months and ≥2 months respectively.[1] **Safety** A review of enoxaparin in neonates reported that minor side effects were common; major bleeding was recorded in 5% neonates.[5] Whether premature infants are at increased risk is unclear. No major bleeds were reported in a series of 10 premature neonates.[7] There are no data addressing the frequency of osteoporosis, HIT, or other hypersensitivity reactions in children exposed to LMWH.[1] Enoxaparin overdose: The optimal management of LMWH overdose in the paediatric population has not been established. In common practice, enoxaparin overdose can be reversed by administration of protamine using a 1: 1 ratio to LMWH (example: 1 mg enoxaparin = 1 mg protamine). The dose of protamine can be given as a single dose or divided into 2-3 doses at 4 hour intervals aiming to return anti-Xa levels to therapeutic range.[4] **Pharmacokinetics** Enoxaparin sodium is obtained by alkaline depolymerisation of heparin benzyl ester derived from porcine intestinal mucosa.[3] Body weight is the most predictive covariate for clearance and central volume of distribution.[1] After injection of Clexane by the subcutaneous route, the product is rapidly and completely absorbed. The absolute bioavailability is over 90%. It is primarily metabolised in the liver. Small amounts are eliminated by kidneys in an intact or slightly degraded form.[3] Elimination is not significantly modified in mild to moderate renal insufficiency.[3]

Practice points	The dose regimen and monitoring recommendations in this formulary is based the American College of Chest Physicians Evidence-Based Clinical Practice Guidelines 2012. These guidelines were based on studies for anticoagulation in neonates that have been part of larger studies reporting on children in general and report use of twice-daily enoxaparin targeted to an anti-Xa range (measured 4-6 h after dose) of 0.5 to 1.0 units/mL.[1] (LOE II, GOR C) Recommendations for dose adjustment are based on cohort studies in children.[8] (LOE IV, GOR C)
References	1. Monagle P, Chan AK, Goldenberg NA, Ichord RN, Journeycake JM, Nowak-Göttl U, Vesely SK. Antithrombotic therapy in neonates and children: antithrombotic therapy and prevention of thrombosis: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest. 2012 Feb 1;141(2):e737S-801S. 2. Michaels LA, Gurian M, Hegyi T, Drachtman RA. Low molecular weight heparin in the treatment of venous and arterial thromboses in the premature infant. Pediatrics. 2004;114:703-707. 3. Clexane. MIMS online. Accessed on 25 August 2020. 4. Wiernikowski JT, Chan A, Lo G. Reversal of anti-thrombin activity using protamine sulfate. Experience in a neonate with a 10-fold overdose of enoxaparin. Thrombosis research. 2007 Jan 1;120(2):303-5. 5. Malowany JI, Monagle P, Knoppert DC, Lee DS, Wu J, McCusker P, Massicotte MP, Williams S, Chan AK. Enoxaparin for neonatal thrombosis: a call for a higher dose for neonates. Thrombosis research. 2008 Jan 1;122(6):826-30. 6. Malowany JI, Knoppert DC, Chan AK, Pepelassis D, Lee DS. Enoxaparin use in the neonatal intensive care unit: experience over 8 years. Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy. 2007 Sep;27(9):1263-71. 7. Michaels LA, Gurian M, Hegyi T, Drachtman RA. Low molecular weight heparin in the treatment of venous and arterial thromboses in the premature infant. Pediatrics. 2004;114(3):703-7. 8. Monagle P, Michelson AD, Bovill E, Andrew M. Antithrombotic therapy in children. Chest. 2001 Jan 1;119(1):344S-70S.

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