Fentanyl Intravenous - Standard Concentration

Newborn use only

2025

Alert	S8 High risk medicine. Must be stored and handled according to local S8 drug policy High risk of causing significant patient harm when used in error.
Indication	Analgesia. Sedation.
Action	Binds to specific G protein-coupled opioid receptors that are located in brain and spinal cord regions involved in the transmission and modulation of pain.
Drug type	Opioid analgesic agent.
Trade name	Aspen Fentanyl; DBL Fentanyl; Fentanyl GH; Fentanyl Solution (AstraZeneca); Sublimaze
Presentation	500 microgram/10 mL ampoule; 100 microgram/2 mL ampoule
Dose	**Bolus/loading dose** 0.5–4 microgram/kg/dose over 3–5 minutes – may be required every 2–4 hours. **Continuous IV Infusion** 1–5 microgram/kg/hour. General starting dose: 1 microgram/kg/hour. Titrate using a validated pain score. **Pre-medication for intubation** 2–4 microgram/kg bolus. Wait at least 3 minutes for onset of action after giving the dose.
Dose adjustment	Therapeutic hypothermia – Insufficient evidence to recommend any dose adjustment. (22, 25) ECMO - Higher doses may be needed for procedural analgesia (23,25) Hepatic impairment - May not need any change (24) Renal impairment - May not need any change (21)
Maximum dose	
Total cumulative dose	
Route	IV
Preparation	**Note: Refer to Appendix for tables to assist with concentration selection.** **20mL Syringe** **4 microgram/mL infusion (suggested weight <1 kg)** Draw up 1.6 mL (80 microgram) of fentanyl and add 18.4 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 20 mL. **1 microgram/kg/hour = 0.25 mL/kg/hour.** IV bolus from this solution: 1 microgram/kg = 0.25 mL/kg. **10 microgram/mL infusion (suggested weight 1 to <3 kg)** Draw up 4 mL (200 microgram) of fentanyl and add 16 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 20 mL. **1 microgram/kg/hour = 0.1 mL/kg/hour.** IV bolus from this solution: 1 microgram/kg = 0.1 mL/kg. **20 microgram/mL infusion (suggested weight ≥3 kg)** Draw up 8 mL (400 microgram) of fentanyl and add 12 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 20 mL. **1 microgram/kg/hour = 0.05 mL/kg/hour.** IV bolus from this solution: 1 microgram/kg = 0.05 mL/kg. **50mL Syringe** **4 microgram/mL infusion (suggested weight <1 kg)** Draw up 4 mL (200 microgram) of fentanyl and add 46 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 50 mL. **1 microgram/kg/hour = 0.25 mL/kg/hour.** IV bolus from this solution: 1 microgram/kg = 0.25 mL/kg. **10 microgram/mL infusion (suggested weight 1 to <3 kg)** Draw up 10 mL (500 microgram) of fentanyl and add 40 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 50 mL.

	1 microgram/kg/hour = 0.1 mL/kg/hour. IV bolus from this solution: 1 microgram/kg = 0.1 mL/kg. **20 microgram/mL infusion (suggested weight ≥3 kg)** Draw up 20 mL (1000 microgram) of fentanyl and add 30 mL of sodium chloride 0.9% or glucose 5% or glucose 10% to make a final volume of 50 mL. **1 microgram/kg/hour = 0.05 mL/kg/hour.** IV bolus from this solution: 1 microgram/kg = 0.05 mL/kg. **IV BOLUS/LOADING DOSE** Draw up 0.4 mL (20 microgram) of fentanyl and add 9.6 mL of sodium chloride 0.9% to make a final volume of 10 mL with a concentration of 2 microgram/mL. Note: If a continuous infusion is running, bolus doses/loading dose can be calculated and given from the continuous infusion solution. **PRE-MEDICATION FOR INTUBATION** As above for IV bolus.
Administration	Slow IV bolus over 3−5 minutes Continuous IV infusion
Monitoring	Hepatic and renal function. Full cardiorespiratory monitoring is required. Monitor for urinary retention.
Contraindications	Known hypersensitivity to fentanyl.
Precautions	Tolerance can occur with use >5−7 days. Withdrawal has been reported in patients who have received continuous infusions for >5days. Chest wall rigidity can occur at any dose. May cause respiratory depression. May cause urinary retention. May decrease intestinal motility.
Drug interactions	Ketoconazole and erythromycin are potent inhibitors of fentanyl metabolism. When given in combination with amiodarone can cause profound bradycardia, sinus arrest and hypotension.
Adverse reactions	Nausea and/or vomiting Muscle/chest wall rigidity (usually naloxone responsive). Naloxone 20-40 micrograms/kg reversed muscle rigidity immediately allowing resuscitation in a case series of 8 patients.(11) At high doses can cause neuro-excitation and rarely seizure like activity/myoclonic movements. Respiratory depression. Bradycardia (usually atropine responsive). Urinary retention.
Compatibility	**Fluids:** Sodium chloride 0.9%, glucose 5%, glucose 10% (not tested) **Y-site** (16,17): Acetaminophen, acyclovir, alfentanil, alprostadil, amikacin, amiodarone, amphotericin B lipid complex, amphotericin B liposome, ascorbic acid, atenolol, atropine, azathioprine, aztreonam, caffeine citrate, calcium chloride, calcium gluconate, caspofungin, cefalotin, cefazolin, cefotaxime, cefoxitin, ceftazidime, ceftriaxone, ciclosporin, clindamycin, clonidine, cloxacillin, dexamethasone, dexmedetomidine, digoxin, diltiazem, dobutamine, dopamine, doxycycline, enalaprilat, epinephrine, epoeitin alfa, erythromycin lactobionate, fluconazole, fluorouracil, folic acid (sodium salt), fosphenytoin, furosemide, ganciclovir, gentamicin, glycopyrrolate, heparin, hydrocortisone sodium succinate, imipenem-cilastatin, indomethacin, insulin, labetolol, lidocaine, linezolid, lorazepam, magnesium sulfate, meropenem-vaborbactam, methylprednisolone sodium succinate, metronidazole, midazolam, milrinone, morphine sulfate, naloxone, netilmicin, nitroglycerin, nitroprusside sodium, norepinephrine, octreotide, oxacillin, pamidronate, pancuronium, papaverine, penicillin G sodium, penicillin G potassium, pentobarbital, phenobarbital, phenylephrine, piperacillin, piperacillin-tazobactam, potassium chloride, potassium acetate, propofol, propranolol, protamine, pyridoxine, ranitidine, remifentanil, rocuronium, sodium acetate, sodium bicarbonate, streptokinase, succinylcholine, thiamine, thiopental, ticarcillin, tobramycin, tolazoline, urokinase, vancomycin, vasopressin, vecuronium, verapamil.

	Variable compatibility: amphotericin B conventional colloidal, ampicillin, azithromycin, diazepam, hydralazine.
Incompatibility	Fluids: No information. Y-site (16,17): Diazoxide, pantoprazole, phenytoin, sulfamethoxazole-trimethoprim.
Stability	Protect from light.
Storage	Ampoule: Store below 25°C. Protect from light. Discard remainder after use (in line with S8 drug legislation). Store in Dangerous Drug (DD) safe and record use in DD register.
Excipients	
Special comments	
Evidence	**Background** Fentanyl is a synthetic opioid analgesic, used in neonates because of rapid analgesia, hemodynamic stability, blocking stress responses and preventing increases in pulmonary vascular resistance. Fentanyl is highly lipophilic, crosses the blood brain barrier rapidly, accumulates in fatty tissues, and causes less histamine release than morphine. Fentanyl has greater analgesic potency, a faster onset and shorter duration of action than morphine. Tolerance to fentanyl develops more rapidly than to morphine, requiring the escalation of doses during prolonged administration.(18) **Efficacy** **Analgesia:** Opioids are to be used selectively based on clinical judgment and evaluation of pain indicators, although there are limitations to pain measurement in newborns (1) (LOE 1 GOR B). Continuous infusion of fentanyl 1.1 micrograms/kg/hour (range 0.5-2.0) in the post-operative period achieves acceptable pain control but there may be increased need for ventilator support (2) (LOE II, GOR C). **Premedication for intubation:** Combinations including fentanyl reported in several small trials (3-6) and a cohort study (7). Fentanyl 2 microgram/kg - succinylcholine 2 mg/kg - atropine 20 microgram/kg combination was reported to result in better intubation condition than remifentanil (3 microgram/kg) - atropine 20 microgram/kg in newborn infants. Chest wall rigidity was reported in both groups (3) [LOE II]. A review concluded, based on current evidence, an optimal protocol for premedication is to administer a vagolytic (intravenous atropine), a rapid-acting analgesic (IV fentanyl 3 µg/kg to 5 µg/kg; slow infusion) and a short-duration muscle relaxant (IV succinylcholine) (8). [LOE III-2 GOR C] **Analgesia/sedation for mechanical ventilation:** A short course of low dose fentanyl by infusion reduces behavioural sedation scores, O2 desaturations and neuroendocrine stress responses in preterm ventilated infants (9) (LOE II, GOR B). (2)In very preterm infants on mechanical ventilation, continuous fentanyl infusion plus boluses of fentanyl reduces acute pain and increases side effects but does not reduce prolonged pain compared with boluses of fentanyl alone (10) (LOE II GOR B). **Fentanyl versus morphine conversion factor:** Exact conversion factor for converting fentanyl to morphine remains unknown with literature reporting up to 100:1 for a variety of age groups. A more conservative conversion factor of 10-20 has been found to be effective for neonates. (19,20) **Fentanyl versus morphine analgesia:** In a randomized double-blind trial, neonates were allocated to receive a continuous infusion of fentanyl (10.5 microgram/kg over a 1-hour period followed by 1.5 microgram/kg/hr) or morphine (140 microgram/kg over a 1-hour period followed by 20 microgram/kg/hr) for at least 24 hours. The analgesic effect was similar in both groups. Decreased gastrointestinal motility was less frequent in the fentanyl group (23% vs 47%, P < .01).(20) **Safety** Respiratory depression occurs when anaesthetic doses (greater than 5 microgram/kg/min) are used and may also occur unexpectedly because of redistribution. Chest wall rigidity has occurred in 4% of neonates who received doses of 2.2 to 6.5 microgram/kg, occasionally associated with laryngospasm (11) (LOE IV GOR D). This was reversible with administration of naloxone. When controlling for other variables, the cumulative fentanyl dose did not correlate with neurodevelopmental outcomes in very low birth weight infants (12) (LOE III GOR C). Tolerance may develop to analgesic doses (13). Significant withdrawal symptoms have been reported in patients treated with continuous infusion and was universal for infants receiving >2.5 mg or >9 days infusion (14). [LOE IV GOR D] **Pharmacokinetics** Fentanyl is metabolised in the liver (CYP3A4) and excreted in the urine. Half-life was 9.5 hours (range 5.7 to 12.7 hours). There is significant correlation between postnatal age and total body clearance (15).

	Fentanyl clearance is very low during the first days of life in very preterm infants which can lead to accumulation of the drug. Clearance increases with gestational age as well as with postnatal age. Bodyweight-based fentanyl dose needs to be reduced during the first days of life to achieve comparable exposure across all preterm infants.(26)
Practice points	
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Appendix

Infusion tables to assist with concentration selection

Table 1: Infusion rates when using fentanyl concentration **4 microgram/mL**
(suggested weight <1 kg)

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	**Approximate microgram/kg/hour**									
0.5	0.8	1.6	2.4	3.2	4.0	4.8	5.6	6.4	7.2	8
1	0.4	0.8	1.2	1.6	2.0	2.4	2.8	3.2	3.6	4
1.5	0.3	0.5	0.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7
2	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
2.5	0.2	0.3	0.5	0.6	0.8	1	1.1	1.3	1.4	1.6
3	0.1	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3
3.5	0.1	0.2	0.3	0.5	0.6	0.7	0.8	0.9	1	1.1
4	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
4.5	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.7	0.8	0.9
5	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8

Table 2: Infusion rates when using fentanyl concentration **10 microgram/mL**
(suggested weight 1 to <3kg)

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	**Approximate microgram/kg/hour**									
0.5	2	4	6	8	10	12	14	16	18	20
1	1	2	3	4	5	6	7	8	9	10
1.5	0.7	1.3	2	2.7	3.3	4	4.7	5.3	6	6.7
2	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
2.5	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4
3	0.3	0.7	1	1.3	1.7	2	2.3	2.7	3	3.3
3.5	0.3	0.6	0.9	1.1	1.4	1.7	2	2.3	2.6	2.9
4	0.3	0.5	0.8	1	1.3	1.5	1.8	2	2.3	2.5
4.5	0.2	0.4	0.7	0.9	1.1	1.3	1.6	1.8	2	2.2
5	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2

Table 3: Infusion rates when using fentanyl concentration **20 microgram/mL**
(suggested weight ≥3kg)

Rate (mL/hr)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
Weight (kg)	**Approximate microgram/kg/hour**									
0.5	4	8	12	16	20	24	28	32	36	40
1	2	4	6	8	10	12	14	16	18	20
1.5	1.3	2.7	4	5.3	6.7	8	9.3	10.7	12	13.3
2	1	2	3	4	5	6	7	8	9	10
2.5	0.8	1.6	2.4	3.2	4	4.8	5.6	6.4	7.2	8
3	0.7	1.3	2	2.7	3.3	4	4.7	5.3	6	6.7
3.5	0.6	1.1	1.7	2.3	2.9	3.4	4	4.6	5.1	5.7
4	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
4.5	0.4	0.9	1.3	1.8	2.2	2.7	3.1	3.6	4	4.4
5	0.4	0.8	1.2	1.6	2	2.4	2.8	3.2	3.6	4

$$\text{Dose (microgram/kg/hour)} = \frac{\text{Rate (mL/hr)} \times \text{Concentration (microgram/mL)}}{\text{Weight (kg)}}$$

$$\text{Rate (mL/hr)} = \frac{\text{Dose (microgram/kg/hour)} \times \text{Weight (kg)}}{\text{Concentration (microgram/mL)}}$$

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