ALTERNATIVE PARENTERAL AGENTS FOR ANALGESIA AND SEDATION

AGENT	PK	BOLUS/LOAD	INFUSION	TITRATION	MONITORING	COMPOUNDING	INCOMPATIBILITIES
SEDATIVE INFUSIONS							
Clonidine **OFF LABEL USE** Standard conc: 500mcg/50mL NS	Onset: 30-60 min $T_{1/2}$: 6-13 hr	3 to 5 mcg/kg IV[6] *max 0.3 mg	**Start:** 1.5 mcg/kg/hr **Range:** 1 to 3 mcg/kg/hr[6]	Adjust dosage hourly by 0.75 mcg/kg/hr, titrating to effect. Max: 3 mcg/kg/hr.[7] Caution in renal dysfunction	Continuous: BP and HR *monitor closely in renal impairment ADRs: hypotension, bradycardia, dry mouth, dry eyes, nausea, and otalgia.	**COMPOUND/DILUENT:** In NS; a typical dilution is 500 mcg/50 mL (0.1 mg/mL).[8] Similar dilutions trialed in 50 mL of D5W.[7] **MAXIMUM CONCENTRATION**: 0.2 mg/mL in NS[4]	No incompatibilities have been recognized in NS.
Chlorpromazine **OFF LABEL USE** Standard conc: 25mg/500mL NS	Onset: 15-30 min $T_{1/2}$: 2-30 hr	12.5 to 50 mg IV[1] *administer at 1 mg/min	**Start:** 0.05 mg/kg/hr **Range:** 0.05 to 0.2 mg/kg/hr[2] *maximum 60 mg/hr	Start low and titrate slowly. Do not exceed max rate. Consider lower doses in geriatric patients.	Continuous: BP Baseline and as indicated: EKG ADRs: Dystonic movements have been reported. Incident arrhythmias have been seen at high doses, mostly among patients with concurrent electrolyte abnormalities.[3]	Stable in sodium chloride 0.9% (NS) and dextrose 5% (D5W). Dilute 25-50 mg in 500-1000 mL of NS. MAXIMUM CONCENTRATION:[4,5] 1 mg/mL in NS. Literature review suggests max concentration of 0.25 mg/mL for D5W	Numerous Y-site incompatibilities have been demonstrated, particularly with chlorpromazine concentrations of 2 mg/mL or greater.[4] Some examples include acyclovir, bumetanide, cefazolin, and cefepime.
Haloperidol lactate	Onset: 0.5-1 hr $t_{1/2}$ = 10-20 hrs	0.5 to 5 mg IV *max 10 mg, administered	**Start:** 10 mg/hr[10] **Range:**	Adjust dose by 5 mg/hr every 30 minutes	Baseline EKG, repeated 2 to 3 times daily or	**COMPOUND/DILUENT:** D_5W is the preferred diluent. Stability is demonstrated with 100	Numerous Y-site incompatibilities, including acyclovir, bumetanide, and

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OFF LABEL USE Standard conc: 100mg/100mL D5W		over 1 minute, for cases of severe agitation	5 to 25 mg/hr IV[10] Soft max: 15 mg/hr[11]	until achieving desired effect. *Caution, accumulation may occur with repeated dosing.	monitor QTc via telemetry strips ADRs: QTc prolongation + arrhythmias have occurred and are associated with baseline QTc and high (>20 mg), intermittent doses.[12,13] **Avoid initiation if baseline QTc is > 500 ms.** Discontinue if QTc becomes > 500 ms or > 20% baseline. Dystonic movements may occur.	mg haloperidol lactate in 100 mL D5W[14] **MAXIMUM CONCENTRATION**:[4] 3mg/mL in D5W, although stability may be limited to 24 hours. For NS, max: 0.75 mg/mL	heparin.[4] See Micromedex.
ANALGESIC INFUSIONS							
Hydromorphone Standard conc: 50mg/50mL NS	*Onset*: 5-15 mins $t_{1/2}$ = 2-3 hrs	1 to 2 mg IV[11] *Administer slowly (over 2-3 mins) to minimize changes in	**Start:** 0.5 to 1 mg/hr IV[11,15] **Range:** Max recommended	Start low; titrate by 0.2 mg/hr q1hr *Titrate more slowly (every q2 hrs) in renal impaired	Continuous: BP and RR. Declining respiratory drive associated with opioid narcotics have been	**COMPOUND/DILUENT:** For continuous infusions, dilute 100 mg hydromorphone in 100 mL of either NS or D5W.[17] Protect from light	Y-site incompatibilities include sodium bicarbonate, tetracyclines, and dexamethasone. Review Micromedex[4]

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		blood pressure[15]	dose is 3 mg/hr. *Weight-based dosing for pediatrics[16]	individuals (< 60 mL/min) as drug will accumulate.	shown to increase intracranial pressure (ICP). Hydromorphone does not suppress cough[15]	**MAXIMUM CONCENTRATION**: 0.1% (1 mg/mL)	
Lidocaine Standard conc: 2000mg/500mL D5W	Onset: 45-90sec $t_{1/2:}$ 1.5-2hr	1.5 mg/kg IV bolus[18] **USE IBW** **Range:** 1.5 to 3 mg/kg[15,18] *Administered over 2-3 minutes.	**Start:** 1-2mg/kg/hour[19] **USE IBW** Max: 200 mg/hr	Titration not needed. May start at target dose.[15] For prolonged infusions (>24 hrs), consider reducing infusion rate by 50% to avoid accumulation.[20] *50% dose-reduction in acute heart failure, acute liver or decompensated cirrhosis[15]	Continuous: BP and EKG Light-headedness is common, altered mentation may occur. Local thrombophlebitis has occurred. Consider therapeutic drug monitoring with prolonged infusions (>24 hrs), with a range 1 to 5 mcg/mL.[21] Neurologic toxicities appear at concentrations > 6 mcg/mL, which includes altered mental status	**COMPOUND/DILUENT**:[15,20] Stable in NS and D5W. Typical dilution is 2 g lidocaine in 250 mL D5W (0.8%) or 500 mL D5W (0.4%). **MAXIMUM CONCENTRATION**: Stability demonstrated up to 40 mg/mL in both NS and D5W	[4,20] Y-site precipitation has been seen with acyclovir, amphotericin, caspofungin acetate, dantrolene, diazepam, ganciclovir sodium, pantoprazole, phenytoin, and trimethoprim-sulfamethoxazole.[4] See Micromedex for full report.

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					and both visual and auditory disturbances. Respiratory depression and seizure become a concern at levels > 10 mcg/mL[22] **Reversal of Toxicity**: Lipid rescue is indicated for toxic presentations associated with local anesthetics. Benzodiazepines should be used for seizures and amiodarone for resultant arrhythmias.		
Remifentanil Standard conc: 1000mcg/250mL NS	Onset: 1-3min $t_{1/2}$: 3-10min	0.5 to 1 mcg/kg[15,29,30] *If patient weight is > 130% IBW, use IBW[31]	**Start:** 0.05 mcg/kg/min[15] **Range:** 0.05 to 0.25 mcg/kg/min[11,15] *If patient weight is	Titrate by 0.025 mcg/kg/min every 5 minutes, as needed. *Doses > 0.2 mcg/kg/min are associated with	Continuous: RR and SpO_2 Daily monitoring of bowel movements. **Reversal**: Naloxone 0.4 mg IV/SC/ET initially,	COMPOUND/DILUENT: May dilute sterile water for injection (SWFI), D5W, D5W-NS, NS, and 1/2NS, and LR-D5W.[32] MAXIMUM CONCENTRATION: 250 mcg/mL in either NS or D5W[32]	Avoid co-administration with blood products. Y-site incompatibilities include with amphotericin, daptomycin,

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			> 130% IBW, use IBW[31]	respiratory depression. *50% dose-reduction is advised for patients >65yo[30] *Consider lower doses for concomitant sedatives	although larger doses may be required for immediate response. Remifentanil's half-life is brief.		mitomycin, and pantoprazole.[4]
INTERMITTENT PARENTERAL THERAPIES							
Phenobarbital **OFF LABEL USE**	Onset: 5-10min $t_{1/2}$: >48h	7.5 mg/kg IV bolus[9,23] *administered at a maximum rate of 50 mg/min[9,23]	**Intermittent:** 1 to 2 mg/kg/day IV[†‡] divided q8-12hrs; consider dose of 60mg IV q12hr for patients < 90kg [9,23] *Max administration rate 50 mg/min. **Range:** Up to 65-400 mg/day	Adjust dosage by 30-60 mg increments, titrating to desired sedation[23] *If frequent supplemental boluses are required, consider increasing scheduled dose. *When weaning is	Continuous: BP and RR. Daily monitoring of osmolar gap should be considered. If there is suspicion of toxicity and the osmolar gap is elevated, consider ordering a serum propylene glycol level to confirm. Monitor liver function tests as phenobarbital	Large veins preferred. Avoid administration into or adjacent to an artery, as gangrene is an undesired consequence, potentially requiring amputation.[26] Enteral routes are preferred when available. Absorption of phenobarbital is rapid and efficient. **COMPOUND/DILUENT**: Dilute in NS or D5W. Typical dilution is 0 to 100 mg in 50 mL NS, doses more than 100 mg in 100 mL NS.[27]	Parenteral phenobarbital solutions are highly alkaline - avoid infusing with acidic solutions. Protect from light. Some of the known Y-site incompatibilities include cefotaxime, cefoxitin, cefuroxime, cyclosporine, diazepam, doxycycline, epinephrine, midazolam, phenytoin sodium, and

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				desired, reduce daily dose by 50%. At 65 mg daily, discontinue. *Accumulation risk in severe renal failure (CrCl < 10 mL/min)	may be hepatotoxic and may cause more side effects in individuals with reduced liver function. Therapeutic drug monitoring is recommended to avoid toxic levels (> 40 mcg/mL). Target concentrations for sedation are between 5-40 mcg/mL.[26] Phenobarbital is a CYP450 inducer. With time, it may cause increased elimination of hepatically cleared drugs	**MAXIMUM CONCENTRATION**: Concentrations up to 10 mg/mL in NS have been found to be stable.[28]	trimethoprim-sulfamethoxazole.[4] Visit Micromedex for a full list.
Valproic acid **OFF LABEL USE**	Onset: unknown $t_{1/2}$: 9-16hr	20 to 30 mg/kg IV[9] *Max rate 20 mg/min	20 mg/kg/day divided and given q6-8hr[9] *Administered IV, PO, or by enteral tube	Titration not required. Decreased clearance seen in geriatrics and those with	Baseline CBC and LFTs are recommended, with intermittent repeat draws.	**COMPOUND/DILUENT:** May dilute in NS, D5W or lactate ringers (LR).[33] A total volume of 50 mL is typical.	High (>40 mg/mL) concentrations of valproate sodium are incompatible with vancomycin at the Y-site.[4]

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				hepatic impairment. Dose-reduction is advised.[15]	ADRs: Nausea and vomiting is common. Trend serum ammonia if suspecting toxicity. Therapeutic drug monitoring for sedation is poorly defined. Targeting free serum concentrations of 5 to 13 mg/Ml has been suggested.[9]	**MAXIMUM CONCENTRATION:** Not well-defined, but 500 mg in 50 mL (10 mg/mL) is frequently used.	

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