

Table 3: Common Pharmacological Agents Used for Moderate Sedation during Cardiac Catheterization Procedure

Agent	Dose		Pharmacokinetics		Metabolism	Preferred Route of Administration	Reversal Agent	Adverse Effects
	Initial	Maximum	Onset/ Duration	½ life				
Benzodiazepines								
Diazepam	IV: 2.5 mg over 3–5 minutes (reduce to 1.5 mg if age >60)	Maximal of 0.2 mg/kg if no opioids (Max of 0.1 mg/kg if >60 years of age)	0.5–2 hours	15–21 hours	Hepatic	IV	Flumazenil 0.2 mg IV, repeat as needed (max dose 1 mg)	Amnesia, respiratory depression, hypotension, headache, drowsiness, nausea/vomiting, injection-site reactions
Midazolam	IV: 0.02–0.04 mg/kg	Until desired response or 0.1 mg–0.2 mg/kg	2–5 minutes/ less than 2 hours	2–6 hours (prolonged in renal failure, elder, cirrhosis, and HF)	Hepatic	IV	Flumazenil 0.2 mg IV, repeat as needed (max dose 1 mg)	Amnesia, respiratory depression, hypotension, headache, drowsiness, nausea/vomiting, injection-site reactions
Lorazepam	IV: 0.044 mg/kg	4 mg IV	2–3 minutes/ ip to 8 hours	~12–14 hours	Hepatic	IV	Flumazenil 0.2 mg IV, repeat as needed (max dose 1 mg)	Amnesia, respiratory depression, hypotension, headache, drowsiness, nausea/vomiting, injection-site reactions, propylene glycol toxicity (in renal failure)
Non-Benzodiazepines								
Diphenhydramine (adjunctive to other agents)	IV: 25–50 mg given 3 minutes prior to sedation	Not defined for this indication	30–90 minutes/ 4–7 hours	7–18 hours (prolonged in elderly)	Hepatic	IV	None	Hypotension, palpitations, confusion, drowsiness, dry mouth, blurred vision
Ketamine	IV: 1–2 mg/kg, repeat 0.25–0.5 mg/kg every 5–10 minutes after		30 seconds/5–10 minutes	10–15 minutes/ 2 hours	Hepatic	IV	None	Tachycardia, hypertension, laryngospasm, emergence reactions, nausea/vomiting, hypersalivation

Short-Acting Opioids

Fentanyl	IV: 25–100 mcg every 3 minutes	Doses greater than 200 mcg rarely needed unless on chronic opioids)	Immediate/ 0.5–1 hour but increases with more doses	2–4 hours (increase with repeated dosing)	Hepatic/ Intestinal	IV	Naloxone (0.2–2 mg IV repeated 2–3 minutes)	Respiratory depression, apnea, hypotension, nausea/vomiting, pruritus, constipation, cardiac dysrhythmia
Hydro-morphone (Dilaudid)	IV: 0.5–1.5 mg IV over 1–2 minutes	2 mg/hour	1–2 minutes/ 3–4 hours	2–3 hours	Hepatic	IV	Naloxone (0.2–2 mg IV repeated 2–3 minutes)	Respiratory depression, apnea, hypotension, nausea/vomiting, pruritus, constipation
Morphine	IV: 1–4 every 5 minutes	Doses greater than 6 mg rarely needed (unless on chronic opioids)	5–10 minutes/4 hours	2–4 hours	Hepatic	IV	Naloxone (0.2–2 mg IV repeated 2–3 minutes)	Respiratory depression, apnea, hypotension, nausea/vomiting, pruritus, constipation, anaphylaxis, blurry vision, urinary retention

mg = milligram; micrograms = mcg; kg = kilogram; IV = intravenous; HF = heart failure