

Table 1. Anticoagulant Comparison¹⁷⁻¹⁹

Pharmacologic Class	Available Agents (Source)	Route of Administration	Cautions
Direct thrombin inhibitor	Argatroban, Bivalirudin, Desirudin, Lepirudin (recombinant)	IV (Argatroban, Bivalirudin, Lepirudin), Subcutaneous (Desirudin)	<p>May be used safely in patients with heparin-induced thrombocytopenia.</p> <p>Discontinue therapy if the patient requires epidural or spinal puncture. Spinal and epidural hematoma have occurred in patients who concurrently received a direct thrombin inhibitor and underwent an epidural or spinal puncture; long-term or permanent paralysis may result.</p> <p>Lepirudin Elimination may be delayed in patients with renal dysfunction (creatinine clearance < 60 mL/min or serum creatinine > 1.5 mg/dL) and the risk of bleeding may increase. Avoid use, if possible. Adjust dose and monitor activated clotting time or aPTT if lepirudin must be administered. Anaphylaxis and death have occurred in patients receiving both initial and subsequent doses of lepirudin. Patients may develop antihirudin antibodies that may increase the anticoagulant effect of lepirudin.</p> <p>Bivalirudin Dosage adjustments required for patients with renal dysfunction (creatinine clearance < 60 mL/min).</p> <p>Argatroban The elimination of argatroban may be delayed in patients with hepatic dysfunction. Decrease the initial dose or avoid use if possible. If argatroban must be administered, monitor activated clotting time or aPTT.</p> <p>Desirudin – This product will be available in the US in late 2008.²⁰ Elimination may be delayed in patients with renal dysfunction (creatinine clearance < 60 mL/min) and the risk of bleeding may increase. Avoid use, if possible. Adjust dose and monitor activated clotting time or aPTT if desirudin must be administered.</p>

Pharmacologic Class	Available Agents (Source)	Route of Administration	Cautions
Heparin	Heparin sodium (porcine)	Subcutaneous, IV	Induces thrombocytopenia in up to 30% of patients.
Low molecular weight heparins	Dalteparin, Enoxaparin, Tinzaparin (porcine)	Subcutaneous (dalteparin, enoxaparin, tinzaparin), IV (enoxaparin)	<p>Patients with heparin-induced thrombocytopenia may also react to an LMWH. Avoid use in these patients if possible.</p> <p>Limited information on safety or efficacy in patients who are pregnant or obese. Avoid use if possible. If an LMWH must be given, monitor anti-Factor Xa concentrations, especially in patients receiving a weight-based dosage regimen.</p> <p>Drug elimination may be delayed in patients with renal dysfunction (serum creatinine ≥ 2 mg/dL) and the risk of bleeding complications increases. Avoid use if possible. If an LMWH must be given, monitor anti-Factor Xa concentrations.</p> <p>Discontinue therapy if the patient requires epidural or spinal puncture. Spinal and epidural hematoma have occurred in patients who concurrently received an LMWH and underwent an epidural or spinal puncture; long-term or permanent paralysis may result.</p>
Selective Factor Xa inhibitor	Fondaparinux (synthetic)	Subcutaneous	<p>Fondaparinux is unlikely to induce heparin-induced thrombocytopenia, although additional in vivo study is needed to verify this claim. Use with caution in patients with existing heparin-induced thrombocytopenia.</p> <p>Contraindicated in patients weighing < 50 kg and in patients with a creatinine clearance < 30 mL/min due to increased bleeding risk.</p> <p>Drug elimination may be delayed in patients with renal dysfunction (creatinine clearance < 80 mL/min) and the risk of bleeding complications increases. Avoid use if possible. If fondaparinux must be given, monitor anti-Factor Xa concentrations.</p> <p>Discontinue therapy if the patient requires epidural or spinal puncture. Patients receiving concurrent LMWHs, heparinoids, or fondaparinux sodium are at increased risk of developing spinal or epidural hematomas which can result in long-term or permanent paralysis.</p>

Pharmacologic Class	Available Agents (Source)	Route of Administration	Cautions
Citrate	Sodium Citrate 4%, 250 mL or 500 mL (Baxter) (no commercial multi-dose or unit-dose product)	Catheter locking solution	Higher concentrations of sodium citrate have been associated with fatalities. ²¹ Published data using a 4% sodium citrate product available in Canada show efficacy. ²² The available commercial product would require additional pharmacy manipulation to use as it is packaged in a large volume single-use bag. Some centers may choose to use a compounded product available in a smaller presentation. There are concerns with using an extemporaneously compounded sterile product. ²³⁻²⁵ Compounded preparations are not FDA-approved products. ^{23,25} As such, the FDA has no control over the quality or consistency of the manufacturing process. Patients have been seriously injured or have died after receiving poorly prepared compounded injections. ^{24, 26}

Abbreviations: aPTT = activated partial thromboplastin time; IV = intravenous; LMWH = low molecular weight heparin.