Saquinavir (SQV, Invirase) (Last updated May 22, 2018; last reviewed May 22, 2018)

For additional information, see Drugs@FDA: http://www.accessdata.fda.gov/scripts/cder/daf

Formulations

Capsules: 200 mg

Tablets: 500 mg

Dosing Recommendations

Pediatric Dose:

- Not approved for use in infants, children, and adolescents aged <16 years.

Adolescent and Adult Dose:

- Saquinavir should **only** be used in combination with ritonavir.
- Saquinavir 1000 mg plus ritonavir 100 mg twice daily

Selected Adverse Events

- Gastrointestinal intolerance, nausea, and diarrhea
- Elevated transaminases
- Hyperlipidemia
- Hyperglycemia
- Fat maldistribution
- PR interval prolongation, QT interval prolongation, and ventricular tachycardia (Torsades de Pointes)

Special Instructions

- Administer within 2 hours after a full meal.
- Sun exposure can cause photosensitivity reactions; advise patients to use sunscreen or protective clothing.
- Pre-therapy electrocardiogram is recommended; saquinavir is **contraindicated** in patients with a prolonged QT interval.

Metabolism/Elimination

- Cytochrome P450 3A4 (CYP3A4) substrate and inhibitor
- 90% metabolized in the liver
- Use saquinavir with caution in patients who have hepatic impairment; no dose adjustment recommended.

Drug Interactions (see also the Adult and Adolescent Guidelines and the HIV Drug Interaction Checker)

- Saquinavir is both a substrate and inhibitor of the cytochrome P 450 3A4 (CYP3A4) system. Potential exists for multiple drug interactions. Saquinavir **should not be coadministered** with drugs that are highly dependent on CYP3A clearance, especially in cases where elevated plasma concentrations of the coadministered drug can cause serious or life-threatening events.
- Before administration, a patient's medication profile should be carefully reviewed for potential drug interactions.

Major Toxicities

- *More common:* Diarrhea, abdominal discomfort, headache, nausea, paresthesia, skin rash, and lipid

abnormalities.

- *Less common (more severe):* Exacerbation of chronic liver disease, lipodystrophy.
- *Rare:* New-onset diabetes mellitus, hyperglycemia, ketoacidosis, exacerbation of pre-existing diabetes mellitus, spontaneous bleeding in patients with hemophilia, pancreatitis, and elevation in serum transaminases. Saquinavir administered with ritonavir can lead to prolonged QT and/or PR intervals with potential for heart block and ventricular tachycardia (Torsades de Pointes).

Resistance

The International Antiviral Society-USA (IAS-USA) maintains a list of updated resistance mutations and the Stanford University HIV Drug Resistance Database offers a discussion of each mutation.

Pediatric Use

Approval

Saquinavir is not approved for use in children or adolescents aged <16 years.[1]

Efficacy

Saquinavir has been studied with nucleoside reverse transcriptase inhibitors and other protease inhibitors in children with HIV.[2-9] Saquinavir/ritonavir (SQV/r) and a dual-protease inhibitor saquinavir/lopinavir/ritonavir regimen were considered for salvage therapy in children prior to the emergence of the new classes of antiretroviral medications; these regimens **are no longer recommended**.

Pharmacokinetics

Pharmacokinetic (PK) data from children who received SQV/r showed prohibitively low exposure in children younger than 2 years.[10] In children aged ≥2 years, a dose of saquinavir 50 mg/kg twice daily in combination with ritonavir and lopinavir/ritonavir resulted in steady-state plasma trough concentrations (C_{trough}) similar to those seen adults.[9,11] No clinical trials have collected data on the efficacy of saquinavir doses <50 mg/kg in children.

Toxicity

In healthy adult volunteers, SQV/r dose and exposure were associated with increases in both QT and PR intervals.[1,12] Rare cases of Torsades de Pointes and complete heart block have been reported in postmarketing surveillance. SQV/r **is not recommended** for adolescent and adult patients with any of the following conditions: documented congenital or acquired QT prolongation, pretreatment QT interval of >450 milliseconds, refractory hypokalemia or hypomagnesemia, complete atrioventricular block without implanted pacemakers, at risk of complete atrioventricular block, or the use of other drugs that prolong QT interval. An electrocardiogram (EKG) is recommended before initiation of therapy with saquinavir and repeat EKGs should be considered during therapy.

Steady-state saquinavir exposures observed in one pediatric trial (NV20911) were substantially higher than those seen in historical data from adults with QT and PR prolongation.[1,12] Although no EKG abnormalities have been reported among the small number of subjects in pediatric trials, pediatric PK/pharmacodynamics modeling suggests that reducing the saquinavir dose in order to minimize the risk of QT prolongation would decrease saquinavir efficacy in children. Pediatric saquinavir dose recommendations that were both reliably effective and below the thresholds of concern for QT and PR prolongation were not determined.

References

1. Saquinavir [package insert]. Food and Drug Administration. 2015. Available at http://www.accessdata.fda.gov/drugsatfda_docs/label/2015/020628s43-021785s19lbl.pdf.
2. Ananworanich J, Kosalaraksa P, Hill A, et al. Pharmacokinetics and 24-week efficacy/safety of dual boosted saquinavir/

lopinavir/ritonavir in nucleoside-pretreated children. *Pediatr Infect Dis J*. 2005;24(10):874-879. Available at http://www.ncbi.nlm.nih.gov/pubmed/16220084.

3. De Luca M, Miccinesi G, Chiappini E, Zappa M, Galli L, De Martino M. Different kinetics of immunologic recovery using nelfinavir or lopinavir/ritonavir-based regimens in children with perinatal HIV-1 infection. *Int J Immunopathol Pharmacol*. 2005;18(4):729-735. Available at http://www.ncbi.nlm.nih.gov/pubmed/16388722.

4. Grub S, Delora P, Ludin E, et al. Pharmacokinetics and pharmacodynamics of saquinavir in pediatric patients with human immunodeficiency virus infection. *Clin Pharmacol Ther*. 2002;71(3):122-130. Available at http://www.ncbi.nlm.nih.gov/pubmed/11907486.

5. Hoffmann F, Notheis G, Wintergerst U, Eberle J, Gurtler L, Belohradsky BH. Comparison of ritonavir plus saquinavir- and nelfinavir plus saquinavir-containing regimens as salvage therapy in children with human immunodeficiency type 1 infection. *Pediatr Infect Dis J*. 2000;19(1):47-51. Available at http://www.ncbi.nlm.nih.gov/pubmed/10643850.

6. Kline MW, Brundage RC, Fletcher CV, et al. Combination therapy with saquinavir soft gelatin capsules in children with human immunodeficiency virus infection. *Pediatr Infect Dis J*. 2001;20(7):666-671. Available at http://www.ncbi.nlm.nih.gov/pubmed/11465838.

7. Palacios GC, Palafox VL, Alvarez-Munoz MT, et al. Response to two consecutive protease inhibitor combination therapy regimens in a cohort of HIV-1-infected children. *Scandinavian journal of infectious diseases*. 2002;34(1):41-44. Available at http://www.ncbi.nlm.nih.gov/pubmed/11874163.

8. Robbins BL, Capparelli EV, Chadwick EG, et al. Pharmacokinetics of high-dose lopinavir-ritonavir with and without saquinavir or nonnucleoside reverse transcriptase inhibitors in human immunodeficiency virus-infected pediatric and adolescent patients previously treated with protease inhibitors. *Antimicrob Agents Chemother*. 2008;52(9):3276-3283. Available at http://www.ncbi.nlm.nih.gov/pubmed/18625762.

9. Bunupuradah T, van der Lugt J, Kosalaraksa P, et al. Safety and efficacy of a double-boosted protease inhibitor combination, saquinavir and lopinavir/ritonavir, in pretreated children at 96 weeks. *Antivir Ther*. 2009;14(2):241-248. Available at http://www.ncbi.nlm.nih.gov/pubmed/19430099.

10. Haznedar J, Zhang A, Labriola-Tompkins E, et al. A pharmacokinetic study of ritonavir-boosted saquinavir in HIV-infected children 4 months to <6 years old. Presented at: 17th Conference on Retroviruses and Opportunistic Infections (CROI); February 16-19, 2010; San Francisco, CA.

11. Kosalaraksa P, Bunupuradah T, Engchanil C, et al. Double boosted protease inhibitors, saquinavir, and lopinavir/ritonavir, in nucleoside pretreated children at 48 weeks. *Pediatr Infect Dis J*. 2008;27(7):623-628. Available at http://www.ncbi.nlm.nih.gov/pubmed/18520443.

12. Zhang X, Jordan P, Cristea L, et al. Thorough QT/QTc study of ritonavir-boosted saquinavir following multiple-dose administration of therapeutic and supratherapeutic doses in healthy participants. *J Clin Pharmacol*. 2012;52(4):520-529. Available at http://www.ncbi.nlm.nih.gov/pubmed/21558456.