

HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use Acetaminophen Injection safely and effectively. See full prescribing information for Acetaminophen Injection.

Acetaminophen Injection, for intravenous use

Initial U.S. Approval: 1951

WARNING: RISK OF MEDICATION ERRORS AND HEPATOTOXICITY

See full prescribing information for complete boxed warning

Take care when prescribing, preparing, and administering Acetaminophen Injection to avoid dosing errors which could result in accidental overdose and death. (5.3)

Acetaminophen Injection contains acetaminophen. Acetaminophen has been associated with cases of acute liver failure, at times resulting in liver transplant and death. Most of the cases of liver injury are associated with the use of acetaminophen at doses that exceed the recommended maximum daily limits, and often involve more than one acetaminophen-containing product. (5.1).

INDICATIONS AND USAGE

Acetaminophen injection is indicated for the:

- Management of mild to moderate pain. (1)
- Management of moderate to severe pain with adjunctive opioid analgesics. (1)
- Reduction of fever. (1)

DOSAGE AND ADMINISTRATION

- Acetaminophen injection may be given as a single or repeated dose. (2.1)
- Acetaminophen injection should be administered only as a 15 minute intravenous infusion. (2.4)

Adults and Adolescents Weighing 50 kg and Over:

- 1,000 mg every 6 hours or 650 mg every 4 hours to a maximum of 4,000 mg per day. Minimum dosing interval of 4 hours. (2.2)

Adults and Adolescents Weighing Under 50 kg:

- 15 mg/kg every 6 hours or 12.5 mg/kg every 4 hours to a maximum of 75 mg/kg per day. Minimum dosing interval of 4 hours. (2.2)

Children:

- Children 2 to 12 years of age: 15 mg/kg every 6 hours or 12.5 mg/kg every 4 hours to a maximum of 75 mg/kg per day. Minimum dosing interval of 4 hours. (2.3)

DOSAGE FORMS AND STRENGTHS

- Injection for intravenous infusion.
- Each 100 mL flexible plastic container has 1,000 mg acetaminophen (10 mg/mL). (3)

CONTRAINDICATIONS

Acetaminophen is contraindicated:

- In patients with known hypersensitivity to acetaminophen or to any of the excipients in the IV formulation. (4)
- In patients with severe hepatic impairment or severe active liver disease. (4)

WARNINGS AND PRECAUTIONS

- Administration of acetaminophen in doses higher than recommended (by all routes of administration and from all acetaminophen-containing

products including combination products) may result in hepatic injury, including the risk of liver failure and death. (5.1)

- Do not exceed the maximum recommended daily dose of acetaminophen (by all routes of administration and all acetaminophen-containing products including combination products). (5.1)
- Take care when prescribing, preparing, and administering acetaminophen injection to avoid dosing errors which could result in accidental overdose and death. (5.3)
- Use caution when administering acetaminophen in patients with the following conditions: hepatic impairment or active hepatic disease, in cases of alcoholism, chronic malnutrition, severe hypovolemia, or severe renal impairment (creatinine clearance \leq 30 mL/min). (5.1)
- Discontinue acetaminophen immediately at the first appearance of skin rash and if symptoms associated with allergy or hypersensitivity occur. Do not use in patients with acetaminophen allergy. (5.2, 5.4)

ADVERSE REACTIONS

The most common adverse reactions in patients treated with acetaminophen were nausea, vomiting, headache, and insomnia in adult patients and nausea, vomiting, constipation, pruritus, agitation, and atelectasis in pediatric patients. (6.1)

To report SUSPECTED ADVERSE REACTIONS, contact Fresenius Kabi USA, LLC, Vigilance & Medical Affairs at 1-800-551-7176 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

DRUG INTERACTIONS

- Substances that induce or regulate hepatic cytochrome enzyme CYP2E1 may alter the metabolism of acetaminophen and increase its hepatotoxic potential. (7.1)
- Chronic oral acetaminophen use at a dose of 4,000 mg/day has been shown to cause an increase in international normalized ratio (INR) in some patients who have been stabilized on sodium warfarin as an anticoagulant. (7.2)

USE IN SPECIFIC POPULATIONS

- Pregnancy: Category C. There are no studies of intravenous acetaminophen in pregnant women. Use only if clearly needed. (8.1)
- Nursing Mothers: Caution should be exercised when administered to a nursing woman. (8.3)
- Pediatric Use: The effectiveness of acetaminophen for the treatment of acute pain and fever has not been studied in pediatric patients less than 2 years of age. The safety and effectiveness of acetaminophen in pediatric patients older than 2 years is supported by evidence from adequate and well-controlled studies in adults with additional safety and pharmacokinetic data for this age group. (8.4)
- Geriatric Use: No overall differences in safety or effectiveness were observed between geriatric and younger subjects. (8.5)
- Hepatic Impairment: Acetaminophen is contraindicated in patients with severe hepatic impairment or severe active liver disease and should be used with caution in patients with hepatic impairment or active liver disease. (4, 5.1, 8.6)
- Renal Impairment: In cases of severe renal impairment, longer dosing intervals and a reduced total daily dose of acetaminophen may be warranted. (5.1, 8.7)

Revised: 10/2015

FULL PRESCRIBING INFORMATION: CONTENTS*

WARNING: RISK OF MEDICATION ERRORS AND HEPATOTOXICITY

1 INDICATIONS AND USAGE

2 DOSAGE AND ADMINISTRATION

- 2.1 General Dosing Information
- 2.2 Recommended Dosage: Adults and Adolescents
- 2.3 Recommended Dosage: Children
- 2.4 Instructions for Intravenous Administration

3 DOSAGE FORMS AND STRENGTHS

4 CONTRAINDICATIONS

5 WARNINGS AND PRECAUTIONS

- 5.1 Hepatic Injury
- 5.2 Serious Skin Reactions
- 5.3 Risk of Medication Errors

5.4 Allergy and Hypersensitivity

6 ADVERSE REACTIONS

6.1 Clinical Trial Experience

7 DRUG INTERACTIONS

- 7.1 Effects of Other Substances on Acetaminophen
- 7.2 Anticoagulants

8 USE IN SPECIFIC POPULATIONS

- 8.1 Pregnancy
- 8.2 Labor and Delivery
- 8.3 Nursing Mothers
- 8.4 Pediatric Use
- 8.5 Geriatric Use
- 8.6 Patients with Hepatic Impairment
- 8.7 Patients with Renal Impairment

10 OVERDOSAGE
11 DESCRIPTION
12 CLINICAL PHARMACOLOGY

- 12.1 Mechanism of Action
- 12.2 Pharmacodynamics
- 12.3 Pharmacokinetics

13 NONCLINICAL TOXICOLOGY

- 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

14 CLINICAL STUDIES

- 14.1 Adult Acute Pain
- 14.2 Adult Fever

14.3 Pediatric Acute Pain and Fever
16 HOW SUPPLIED/STORAGE AND HANDLING

*Sections or subsections omitted from the full prescribing information are not listed.

FULL PRESCRIBING INFORMATION

WARNING: Risk of Medication Errors and Hepatotoxicity

Take care when prescribing, preparing, and administering Acetaminophen Injection to avoid dosing errors which could result in accidental overdose and death. In particular, be careful to ensure that:

- the dose in milligrams (mg) and milliliters (mL) is not confused;
- the dosing is based on weight for patients under 50 kg;
- infusion pumps are properly programmed; and
- the total daily dose of acetaminophen from all sources does not exceed maximum daily limits [*see Warnings and Precautions (5.3)*].

Acetaminophen injection contains acetaminophen. Acetaminophen has been associated with cases of acute liver failure, at times resulting in liver transplant and death. Most of the cases of liver injury are associated with the use of acetaminophen at doses that exceed the maximum daily limits, and often involve more than one acetaminophen-containing product [*see Warnings and Precautions (5.1)*].

1 INDICATIONS AND USAGE

Acetaminophen injection is indicated for:

- the management of mild to moderate pain
- the management of moderate to severe pain with adjunctive opioid analgesics
- the reduction of fever

2 DOSAGE AND ADMINISTRATION

2.1 General Dosing Information

Acetaminophen injection, for intravenous use, may be given as a single or repeated dose for the treatment of acute pain or fever. No dose adjustment is required when converting

between oral acetaminophen and acetaminophen injection dosing in adults and adolescents who weigh 50 kg and above. Calculated maximum daily dose of acetaminophen is based on all routes of administration (i.e. intravenous, oral, and rectal) and all products containing acetaminophen. Exceeding the maximum mg/kg daily dose of acetaminophen as described in Tables 1 and 2 may result in hepatic injury, including the risk of liver failure and death. To avoid the risk of overdose, ensure that the total amount of acetaminophen from all routes and from all sources does not exceed the maximum recommended dose.

2.2 Recommended Dosage: Adults and Adolescents

Adults and adolescents weighing 50 kg and over: the recommended dosage of acetaminophen injection is 1,000 mg every 6 hours or 650 mg every 4 hours, with a maximum single dose of acetaminophen injection of 1,000 mg, a minimum dosing interval of 4 hours, and a maximum daily dose of acetaminophen of 4,000 mg per day (includes all routes of administration and all acetaminophen-containing products including combination products).

Adults and adolescents weighing under 50 kg: the recommended dosage of acetaminophen injection is 15 mg/kg every 6 hours or 12.5 mg/kg every 4 hours, with a maximum single dose of acetaminophen injection of 15 mg/kg, a minimum dosing interval of 4 hours, and a maximum daily dose of acetaminophen of 75 mg/kg per day (includes all routes of administration and all acetaminophen-containing products including combination products).

Table 1. Dosing for Adults and Adolescents

Age Group	Dose given every 4 hours	Dose given every 6 hours	Maximum single dose	Maximum total daily dose of acetaminophen (by any routes)
Adults and adolescents (13 years and older) weighing ≥ 50 kg	650 mg	1,000 mg	1,000 mg	4,000 mg in 24 hours
Adults and adolescents (13 years and older) weighing < 50 kg	12.5 mg/kg	15 mg/kg	15 mg/kg (up to 750 mg)	75 mg/kg in 24 hours (up to 3,750 mg)

2.3 Recommended Dosage: Children

Children 2 to 12 years of age: the recommended dosage of acetaminophen injection is 15 mg/kg every 6 hours or 12.5 mg/kg every 4 hours, with a maximum single dose of

acetaminophen injection of 15 mg/kg, a minimum dosing interval of 4 hours, and a maximum daily dose of acetaminophen of 75 mg/kg per day.

Table 2. Dosing for Children

Age Group	Dose given every 4 hours	Dose given every 6 hours	Maximum single dose	Maximum total daily dose of acetaminophen (by any routes)
Children 2 to 12 years of age	12.5 mg/kg	15 mg/kg	15 mg/kg (up to 750 mg)	75 mg/kg in 24 hours (up to 3,750 mg)

2.4 Instructions for Intravenous Administration

For adult and adolescent patients weighing ≥ 50 kg requiring 1,000 mg doses of acetaminophen injection, acetaminophen injection may be administered without further dilution. Examine the flexible plastic container contents before dose preparation or administering. DO NOT USE if particulate matter or discoloration is observed. Administer the contents of the flexible plastic container intravenously over 15 minutes. Use aseptic technique when preparing acetaminophen injection for intravenous infusion. Do not add other medications to the acetaminophen injection flexible plastic container.

For doses less than 1,000 mg, the appropriate dose must be withdrawn from the acetaminophen injection flexible plastic container and placed into a separate container prior to administration. Using aseptic technique, withdraw the appropriate dose (650 mg or weight-based) from an intact sealed acetaminophen injection flexible plastic container and place the measured dose in a separate empty, sterile container (e.g. glass bottle, plastic intravenous container, or syringe) for intravenous infusion to avoid the inadvertent delivery and administration of the total volume of the commercially available container. The entire 100 mL flexible plastic container of acetaminophen injection is not intended for use in patients weighing less than 50 kg. Acetaminophen injection is provided in a single-use flexible plastic container and the unused portion must be discarded.

Place small volume pediatric doses up to 60 mL in volume in a syringe and administer over 15 minutes using a syringe pump.

Monitor the end of the infusion in order to prevent the possibility of an air embolism, especially in cases where the acetaminophen injection infusion is the primary infusion.

Once the seal of the flexible plastic container has been penetrated, or the contents transferred to another container, administer the dose of acetaminophen injection within 6 hours.

Do not add other medications to the acetaminophen injection solution. Diazepam and chlorpromazine hydrochloride are physically incompatible with acetaminophen injection, therefore do not administer simultaneously.

3 DOSAGE FORMS AND STRENGTHS

Acetaminophen injection is a sterile, clear, colorless, non-pyrogenic, preservative free, isotonic formulation of acetaminophen intended for intravenous infusion. Each 100 mL flexible plastic container has 1,000 mg acetaminophen (10 mg/mL).

4 CONTRAINDICATIONS

Acetaminophen is contraindicated:

- in patients with known hypersensitivity to acetaminophen or to any of the excipients in the intravenous formulation.
- in patients with severe hepatic impairment or severe active liver disease [*see Warnings and Precautions (5.1)*].

5 WARNINGS AND PRECAUTIONS

5.1 Hepatic Injury

Administration of acetaminophen in doses higher than recommended may result in hepatic injury, including the risk of liver failure and death [*see Overdosage (10)*]. Do not exceed the maximum recommended daily dose of acetaminophen [*see Dosage and Administration (2)*]. The maximum recommended daily dose of acetaminophen includes all routes of administration and all acetaminophen-containing products administered, including combination products.

Use caution when administering acetaminophen in patients with the following conditions: hepatic impairment or active hepatic disease, alcoholism, chronic malnutrition, severe hypovolemia (e.g., due to dehydration or blood loss), or severe renal impairment (creatinine clearance ≤ 30 mL/min) [*see Use in Specific Populations (8.6, 8.7)*].

5.2 Serious Skin Reactions

Rarely, acetaminophen may cause serious skin reactions such as acute generalized exanthematous pustulosis (AGEP), Stevens-Johnson Syndrome (SJS), and toxic epidermal necrolysis (TEN), which can be fatal. Patients should be informed about the signs of serious skin reactions, and use of the drug should be discontinued at the first appearance of skin rash or any other sign of hypersensitivity.

5.3 Risk of Medication Errors

Take care when prescribing, preparing, and administering acetaminophen injection in order to avoid dosing errors which could result in accidental overdose and death. In particular, be careful to ensure that:

- the dose in milligrams (mg) and milliliters (mL) is not confused;
- the dosing is based on weight for patients under 50 kg;
- infusion pumps are properly programmed; and
- the total daily dose of acetaminophen from all sources does not exceed maximum daily limits [see *Dosage and Administration (2)*].

5.4 Allergy and Hypersensitivity

There have been post-marketing reports of hypersensitivity and anaphylaxis associated with the use of acetaminophen. Clinical signs included swelling of the face, mouth, and throat, respiratory distress, urticaria, rash, and pruritus. There were infrequent reports of life-threatening anaphylaxis requiring emergent medical attention. Discontinue acetaminophen immediately if symptoms associated with allergy or hypersensitivity occur. Do not use acetaminophen in patients with acetaminophen allergy.

6 ADVERSE REACTIONS

The following serious adverse reactions are discussed elsewhere in the labeling:

- Hepatic Injury [see *Warnings and Precautions (5.1)*]
- Serious Skin Reactions [see *Warnings and Precautions (5.2)*]
- Allergy and Hypersensitivity [see *Warnings and Precautions (5.4)*]

6.1 Clinical Trial Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed cannot be directly compared to rates in other clinical trials and may not reflect the rates observed in practice.

Adult Population

A total of 1,020 adult patients have received acetaminophen in clinical trials, including 37.3% (n=380) who received 5 or more doses, and 17% (n=173) who received more than 10 doses. Most patients were treated with acetaminophen 1,000 mg every 6 hours. A total of 13.1% (n=134) received acetaminophen 650 mg every 4 hours.

All adverse reactions that occurred in adult patients treated with either acetaminophen or placebo in repeated dose, placebo-controlled clinical trials at an incidence $\geq 3\%$ and at a greater frequency than placebo are listed in Table 3. The most common adverse events in adult patients treated with acetaminophen (incidence $\geq 5\%$ and greater than placebo) were nausea, vomiting, headache, and insomnia.

Table 3. Treatment-Emergent Adverse Reactions Occurring $\geq 3\%$ in Acetaminophen-treated Patients and at a greater frequency than Placebo in Placebo-Controlled, Repeated Dose Studies

System Organ Class - Preferred Term	Acetaminophen (N=402) n (%)	Placebo (N=379) n (%)
Gastrointestinal Disorders		
Nausea	138 (34)	119 (31)
Vomiting	62 (15)	42 (11)
General Disorders and Administration Site Conditions		
Pyrexia*	22 (5)	52 (14)
Nervous System Disorders		
Headache	39 (10)	33 (9)
Psychiatric Disorders		
Insomnia	30 (7)	21 (5)

* Pyrexia adverse reaction frequency data is included in order to alert healthcare practitioners that the antipyretic effects of acetaminophen may mask fever.

Other Adverse Reactions Observed During Clinical Studies of Acetaminophen in Adults

The following additional treatment-emergent adverse reactions were reported by adult subjects treated with acetaminophen in all clinical trials (n=1,020) that occurred with an incidence of at least 1% and at a frequency greater than placebo (n=525).

Blood and lymphatic system disorders: anemia

General disorders and administration site conditions: fatigue, infusion site pain, edema peripheral

Investigations: aspartate aminotransferase increased, breath sounds abnormal

Metabolism and nutrition disorders: hypokalemia

Musculoskeletal and connective tissue disorders: muscle spasms, trismus

Psychiatric disorders: anxiety

Respiratory, thoracic and mediastinal disorders: dyspnea

Vascular disorders: hypertension, hypotension

Pediatric Population

A total of 355 pediatric patients (47 neonates, 64 infants, 171 children, and 73 adolescents) have received acetaminophen in active-controlled (n=250) and open-label clinical trials (n=225), including 59.7% (n=212) who received 5 or more doses and 43.1% (n=153) who received more than 10 doses. Pediatric patients received acetaminophen doses up to 15 mg/kg on an every 4 hours, every 6 hours, or every 8 hours schedule. The maximum exposure was 7.7, 6.4, 6.8, and 7.1 days in neonates, infants, children, and adolescents, respectively.

The most common adverse events (incidence \geq 5%) in pediatric patients treated with acetaminophen were nausea, vomiting, constipation, pruritus, agitation, and atelectasis.

Other Adverse Reactions Observed During Clinical Studies of Acetaminophen in Pediatrics

The following additional treatment-emergent adverse reactions were reported by pediatric subjects treated with acetaminophen (n=355) that occurred with an incidence of at least 1%.

Blood and lymphatic system disorders: anemia

Cardiac disorders: tachycardia

Gastrointestinal disorders: abdominal pain, diarrhea

General disorders and administration site conditions: injection site pain, edema peripheral,

pyrexia

Investigations: hepatic enzyme increase

Metabolism and nutrition disorders: hypoalbuminemia, hypokalemia, hypomagnesemia, hypophosphatemia, hypervolemia

Musculoskeletal and connective tissue disorders: muscle spasm, pain in extremity

Nervous system disorders: headache

Psychiatric disorders: insomnia

Renal and urinary disorders: oliguria

Respiratory, thoracic and mediastinal disorders: pulmonary edema, hypoxia, pleural effusion, stridor, wheezing

Skin and subcutaneous tissue disorders: periorbital edema, rash

Vascular disorders: hypertension, hypotension

7 DRUG INTERACTIONS

7.1 Effects of Other Substances on Acetaminophen

Substances that induce or regulate hepatic cytochrome enzyme CYP2E1 may alter the metabolism of acetaminophen and increase its hepatotoxic potential. The clinical consequences of these effects have not been established. Effects of ethanol are complex, because excessive alcohol usage can induce hepatic cytochromes, but ethanol also acts as a competitive inhibitor of the metabolism of acetaminophen.

7.2 Anticoagulants

Chronic oral acetaminophen use at a dose of 4,000 mg/day has been shown to cause an increase in international normalized ratio (INR) in some patients who have been stabilized on sodium warfarin as an anticoagulant. As no studies have been performed evaluating the short-term use of acetaminophen in patients on oral anticoagulants, more frequent assessment of INR may be appropriate in such circumstances.

8 USE IN SPECIFIC POPULATIONS

8.1 Pregnancy

Pregnancy Category C. There are no studies of intravenous acetaminophen in pregnant women; however, epidemiological data on oral acetaminophen use in pregnant women show no increased risk of major congenital malformations. Animal reproduction studies have not

been conducted with IV acetaminophen, and it is not known whether acetaminophen can cause fetal harm when administered to a pregnant woman. Acetaminophen should be given to a pregnant woman only if clearly needed.

The results from a large population-based prospective cohort, including data from 26,424 women with live born singletons who were exposed to oral acetaminophen during the first trimester, indicate no increased risk for congenital malformations, compared to a control group of unexposed children. The rate of congenital malformations (4.3%) was similar to the rate in the general population. A population-based, case-control study from the National Birth Defects Prevention Study showed that 11,610 children with prenatal exposure to acetaminophen during the first trimester had no increased risk of major birth defects compared to 4,500 children in the control group. Other epidemiological data showed similar results.

While animal reproduction studies have not been conducted with intravenous acetaminophen, studies in pregnant rats that received oral acetaminophen during organogenesis at doses up to 0.85 times the maximum human daily dose (MHDD = 4 grams/day, based on a body surface area comparison) showed evidence of fetotoxicity (reduced fetal weight and length) and a dose-related increase in bone variations (reduced ossification and rudimentary rib changes). Offspring had no evidence of external, visceral, or skeletal malformations. When pregnant rats received oral acetaminophen throughout gestation at doses of 1.2 times the MHDD (based on a body surface area comparison), areas of necrosis occurred in both the liver and kidney of pregnant rats and fetuses. These effects did not occur in animals that received oral acetaminophen at doses 0.3 times the MHDD, based on a body surface area comparison.

In a continuous breeding study, pregnant mice received 0.25, 0.5, or 1% acetaminophen via the diet (357, 715, or 1,430 mg/kg/day). These doses are approximately 0.43, 0.87, and 1.7 times the MHDD, respectively, based on a body surface area comparison. A dose-related reduction in body weights of fourth and fifth litter offspring of the treated mating pair occurred during lactation and post-weaning at all doses. Animals in the high dose group had a reduced number of litters per mating pair, male offspring with an increased percentage of abnormal sperm, and reduced birth weights in the next generation pups.

8.2 Labor and Delivery

There are no adequate and well-controlled studies with acetaminophen during labor and delivery; therefore, it should be used in such settings only after a careful benefit-risk assessment.

8.3 Nursing Mothers

While studies with acetaminophen have not been conducted, acetaminophen is secreted in human milk in small quantities after oral administration. Based on data from more than 15 nursing mothers, the calculated infant daily dose of acetaminophen is approximately 1 to 2% of the maternal dose. There is one well-documented report of a rash in a breast-fed infant that resolved when the mother stopped acetaminophen use and recurred when she resumed acetaminophen use. Caution should be exercised when acetaminophen is administered to a nursing woman.

8.4 Pediatric Use

The safety and effectiveness of acetaminophen for the treatment of acute pain and fever in pediatric patients ages 2 years and older is supported by evidence from adequate and well-controlled studies of acetaminophen in adults. Additional safety and pharmacokinetic data were collected in 355 patients across the full pediatric age strata, from premature neonates (≥ 32 weeks post menstrual age) to adolescents. The effectiveness of acetaminophen for the treatment of acute pain and fever has not been studied in pediatric patients < 2 years of age [*see Dosage and Administration, Recommended Dosage: Children (2.3) and Pharmacokinetics (12.3)*].

8.5 Geriatric Use

Of the total number of subjects in clinical studies of acetaminophen, 15% were age 65 and over, while 5% were age 75 and over. No overall differences in safety or effectiveness were observed between these subjects and younger subjects, and other reported clinical experience has not identified differences in responses between the elderly and younger patients, but greater sensitivity of some older individuals cannot be ruled out.

8.6 Patients with Hepatic Impairment

Acetaminophen is contraindicated in patients with severe hepatic impairment or severe active liver disease and should be used with caution in patients with hepatic impairment or active liver disease [*see Warnings and Precautions (5.1), Clinical Pharmacology (12)*]. A

reduced total daily dose of acetaminophen may be warranted.

8.7 Patients with Renal Impairment

In cases of severe renal impairment (creatinine clearance ≤ 30 mL/min), longer dosing intervals and a reduced total daily dose of acetaminophen may be warranted.

10 OVERDOSAGE

Signs and Symptoms

In acute acetaminophen overdose, dose-dependent, potentially fatal hepatic necrosis is the most serious adverse effect. Renal tubular necrosis, hypoglycemic coma, and thrombocytopenia may also occur. Plasma acetaminophen levels > 300 mcg/mL at 4 hours after oral ingestion were associated with hepatic damage in 90% of patients; minimal hepatic damage is anticipated if plasma levels at 4 hours are < 150 mcg/mL or < 37.5 mcg/mL at 12 hours after ingestion. Early symptoms following a potentially hepatotoxic overdose may include: nausea, vomiting, diaphoresis, and general malaise. Clinical and laboratory evidence of hepatic toxicity may not be apparent until 48 to 72 hours post-ingestion.

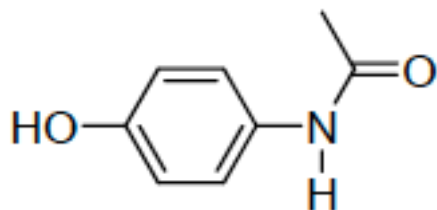
Treatment

If an acetaminophen overdose is suspected, obtain a serum acetaminophen assay as soon as possible, but no sooner than 4 hours following oral ingestion. Obtain liver function studies initially and repeat at 24-hour intervals. Administer the antidote N-acetylcysteine (NAC) as early as possible. As a guide to treatment of acute ingestion, the acetaminophen level can be plotted against time since oral ingestion on a nomogram (Rumack-Matthew). The lower toxic line on the nomogram is equivalent to 150 mcg/mL at 4 hours and 37.5 mcg/mL at 12 hours. If serum level is above the lower line, administer the entire course of NAC treatment. Withhold NAC therapy if the acetaminophen level is below the lower line.

For additional information, call a poison control center at 1-800-222-1222.

11 DESCRIPTION

Acetaminophen is a non-salicylate antipyretic and non-opioid analgesic agent. Its chemical name is N-acetyl-p-aminophenol. Its structural formula is:



M.W. 151.16

Acetaminophen injection, for intravenous use, is a sterile, clear, colorless, non-pyrogenic, isotonic formulation of acetaminophen intended for intravenous infusion. It has a pH of approximately 5.5 and an osmolality of approximately 290 mOsm/kg. Each 100 mL contains acetaminophen, USP, 1,000 mg; mannitol, 3,670 mg and cysteine, 10 mg. pH is adjusted with hydrochloric acid and/or sodium hydroxide.

12 CLINICAL PHARMACOLOGY

12.1 Mechanism of Action

The precise mechanism of the analgesic and antipyretic properties of acetaminophen is not established but is thought to primarily involve central actions.

12.2 Pharmacodynamics

Acetaminophen has been shown to have analgesic and antipyretic activities in animal and human studies.

Single doses of acetaminophen up to 3,000 mg and repeated doses of 1,000 mg every 6 hours for 48 hours have not been shown to cause a significant effect on platelet aggregation. Acetaminophen does not have any immediate or delayed effects on small-vessel hemostasis. Clinical studies of both healthy subjects and patients with hemophilia showed no significant changes in bleeding time after receiving multiple doses of oral acetaminophen.

12.3 Pharmacokinetics

Distribution

The pharmacokinetics of acetaminophen have been studied in patients and healthy subjects from premature neonates up to adults 60 years old. The pharmacokinetic profile of acetaminophen has been demonstrated to be dose proportional in adults following administration of single doses of 500, 650, and 1,000 mg.

The maximum concentration (C_{max}) occurs at the end of the 15 minute intravenous infusion of acetaminophen. Compared to the same dose of oral acetaminophen, the C_{max} following administration of acetaminophen is up to 70% higher, while overall exposure (area under the concentration time curve [AUC]) is very similar.

Pharmacokinetic parameters of acetaminophen (AUC, C_{max} , terminal elimination half-life [$T_{1/2}$], systemic clearance [CL], and volume of distribution at steady state [Vss]) following administration of a single intravenous dose of 15 mg/kg for the pediatric population and 1,000 mg in adults are summarized in Table 4.

Table 4. Acetaminophen Pharmacokinetic Parameters

Subpopulations	Mean (SD)				
	AUC (mcg x h/mL)	C_{max} (mcg/mL)	$T_{1/2}$ (h)	CL (L/h/kg)	Vss (L/kg)
Neonates	62 (11)	25 (4)	7 (2.7)	0.12 (0.04)	1.1 (0.2)
Infants	57 (54)	29 (24)	4.2 (2.9)	0.29 (0.15)	1.1 (0.3)
Children	38 (8)	29 (7)	3 (1.5)	0.34 (0.10)	1.2 (0.3)
Adolescents	41 (7)	31 (9)	2.9 (0.7)	0.29 (0.08)	1.1 (0.3)
Adults	43 (11)	28 (21)	2.4 (0.6)	0.27 (0.08)	0.8 (0.2)

The pharmacokinetic exposure of acetaminophen observed in children and adolescents is similar to adults, but higher in neonates and infants. Dosing simulations from pharmacokinetic data in infants and neonates suggest that dose reductions of 33% in infants 1 month to < 2 years of age, and 50% in neonates up to 28 days, with a minimum dosing interval of 6 hours, will produce a pharmacokinetic exposure similar to that observed in children age 2 years and older.

At therapeutic levels, binding of acetaminophen to plasma proteins is low (ranging from 10% to 25%). Acetaminophen appears to be widely distributed throughout most body tissues except fat.

Metabolism and Excretion

Acetaminophen is primarily metabolized in the liver by first-order kinetics and involves three principal separate pathways: Conjugation with glucuronide, conjugation with sulfate,

and oxidation via the cytochrome P450 enzyme pathway, primarily CYP2E1, to form a reactive intermediate metabolite (N-acetyl-p-benzoquinone imine or NAPQI). With therapeutic doses, NAPQI undergoes rapid conjugation with glutathione and is then further metabolized to form cysteine and mercapturic acid conjugates.

Acetaminophen metabolites are mainly excreted in the urine. Less than 5% is excreted in the urine as unconjugated (free) acetaminophen and more than 90% of the administered dose is excreted within 24 hours.

13 NONCLINICAL TOXICOLOGY

13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

Carcinogenesis

Long-term studies in mice and rats have been completed by the National Toxicology Program to evaluate the carcinogenic potential of acetaminophen. In 2-year feeding studies, F344/N rats and B6C3F1 mice were fed a diet containing acetaminophen up to 6,000 ppm. Female rats demonstrated equivocal evidence of carcinogenic activity based on increased incidences of mononuclear cell leukemia at 0.8 times the maximum human daily dose (MHDD) of 4 grams/day, based on a body surface area comparison. In contrast, there was no evidence of carcinogenic activity in male rats (0.7 times) or mice (1.2 to 1.4 times the MHDD, based on a body surface area comparison).

Mutagenesis

Acetaminophen was not mutagenic in the bacterial reverse mutation assay (Ames test). In contrast, acetaminophen tested positive in the *in vitro* mouse lymphoma assay and the *in vitro* chromosomal aberration assay using human lymphocytes. In the published literature, acetaminophen has been reported to be clastogenic when administered a dose of 1,500 mg/kg/day to the rat model (3.6 times the MHDD, based on a body surface area comparison). In contrast, no clastogenicity was noted at a dose of 750 mg/kg/day (1.8 times the MHDD, based on a body surface area comparison), suggesting a threshold effect.

Impairment of Fertility

In studies conducted by the National Toxicology Program, fertility assessments have been completed in Swiss mice via a continuous breeding study. There were no effects on fertility

parameters in mice consuming up to 1.7 times the MHDD of acetaminophen, based on a body surface area comparison. Although there was no effect on sperm motility or sperm density in the epididymis, there was a significant increase in the percentage of abnormal sperm in mice consuming 1.7 times the MHDD (based on a body surface area comparison) and there was a reduction in the number of mating pairs producing a fifth litter at this dose, suggesting the potential for cumulative toxicity with chronic administration of acetaminophen near the upper limit of daily dosing.

Published studies in rodents report that oral acetaminophen treatment of male animals at doses that are 1.2 times the MHDD and greater (based on a body surface area comparison) result in decreased testicular weights, reduced spermatogenesis, reduced fertility, and reduced implantation sites in females given the same doses. These effects appear to increase with the duration of treatment. The clinical significance of these findings is not known.

14 CLINICAL STUDIES

14.1 Adult Acute Pain

The efficacy of acetaminophen in the treatment of acute pain in adults was evaluated in two randomized, double-blind, placebo-controlled clinical trials in patients with postoperative pain.

Pain Study 1 evaluated the analgesic efficacy of repeated doses of acetaminophen 1,000 mg vs. placebo every 6 hours for 24 hours in 101 patients with moderate to severe pain following total hip or knee replacement. Acetaminophen was statistically superior to placebo for reduction in pain intensity over 24 hours. There was an attendant decrease in opioid consumption, the clinical benefit of which was not demonstrated.

Pain Study 2 evaluated the analgesic efficacy of repeated doses of acetaminophen 1,000 mg every 6 hours or 650 mg every 4 hours for 24 hours versus placebo in the treatment of 244 patients with moderate to severe postoperative pain after abdominal laparoscopic surgery. Patients receiving acetaminophen experienced a statistically significant greater reduction in pain intensity over 24 hours compared to placebo.

14.2 Adult Fever

The efficacy of acetaminophen 1,000 mg in the treatment of adult fever was evaluated in one randomized, double-blind, placebo-controlled clinical trial. The study was a 6-hour, single-dose, endotoxin-induced fever study in 60 healthy adult males. A statistically significant antipyretic effect of acetaminophen was demonstrated through 6 hours in comparison to placebo. The mean temperature over time is shown in Figure 1.

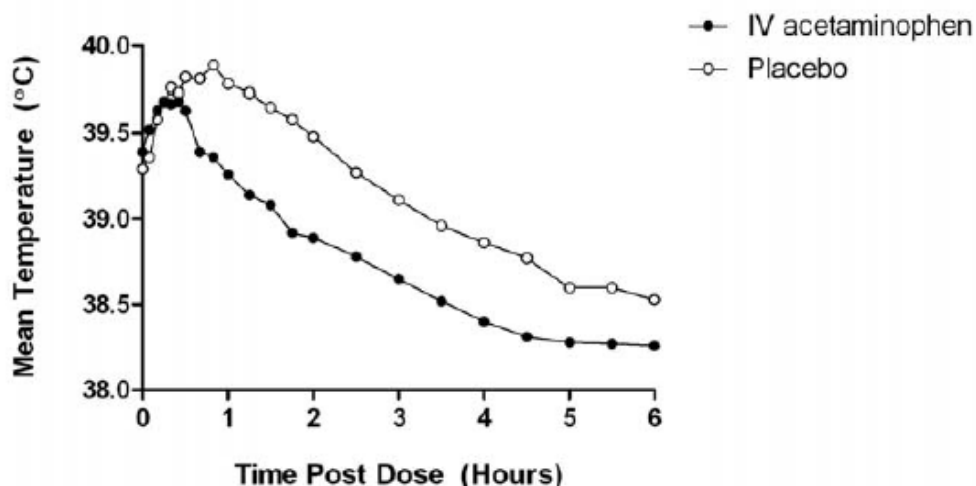


Figure 1: Mean Temperature (°C) Over Time

14.3 Pediatric Acute Pain and Fever

Acetaminophen was studied in 355 pediatric patients in two active-controlled and three open-label safety and pharmacokinetic trials [see *Pediatric Use* (8.4)].

16 HOW SUPPLIED/STORAGE AND HANDLING

Acetaminophen Injection is supplied as follows:

Product No.	NDC No.	Strength	Size
434100	63323-434-00	1,000 mg per 100 mL (10 mg per mL)	100 mL flexible plastic container.

Acetaminophen injection should be stored at 20° to 25°C (68° to 77°F) [see USP Controlled Room Temperature].

For single use only. The product should be used within 6 hours after opening. Do not refrigerate or freeze.

This container is not made with natural rubber latex or polyvinyl chloride (PVC).

Manufactured for:



Made in Norway

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