

SEVOFLURANE

Description and Composition

Sevoflurane is a non-flammable, pleasant smelling, volatile liquid. It is 1, 1, 1, 3, 3, 3-hexafluoro-2-fluoromethylpropane and has the following structural formula:



Some physical constants of Sevoflurane are:	
Relative molecular mass	200.05
Boiling point at 760mmHg	58.6°C
Refractive index n _D ²⁰	1.2740 - 1.2760
Specific gravity at 20°C	1.520 - 1.525
Vapour pressure	Temp/°C
	20 157
	35 197
	36 317

Partition coefficients at 37°C	
Water/gas	0.36
Blood/gas	0.63-0.69
Oil/Olive/gas	47.2-53.9

Mean partition coefficients at 25°C - component/gas	
Concentric rubber	14.0
Bulk polymer	17.4
Polyvinylchloride	17.4
Polyethylene	1.3

Purity by gas chromatography	99.975% or better
Flammability	Not flammable

Indications

Adult and maintenance of general anaesthesia in adult and paediatric patients for inpatient and outpatient surgery.

Posology and Method of Administration

Premedication should be selected according to the need of the individual patient, and at the discretion of the anaesthetist.

Surgical Anaesthesia:

Sevoflurane should be delivered via a vapouriser specifically calibrated for use with Sevoflurane so that the concentration delivered can be accurately controlled. MAC (minimum alveolar concentration) values for Sevoflurane decrease with age and with the addition of nitrous oxide. The table below indicates average MAC values for different age groups.

Table 1: MAC values for Adults and Paediatric patients according to age group		
Age of Patient (years)	Sevoflurane in Oxygen	Sevoflurane in 50% N ₂ O/50% O ₂
0 - 1 months*	3.3%	
1 - 6 months	3.0%	
< 3 years	2.8%	2.0%**
3 - 12	2.5%	
25	2.6%	1.4%
40	2.1%	1.1%
60	1.7%	0.9%
80	1.4%	0.7%

* Neonates are full term gestational age. MAC in preterm is not defined.
** In < 1 - 3 year old paediatric patients, 60% N₂O/40% O₂ was used.

Warnings

Dosage should be individualised and titrated to the desired effect according to the patient's age and clinical status. A

short acting barbiturate or other intravenous induction agent may be administered followed by inhalation of Sevoflurane. Induction with Sevoflurane may be achieved by oxygen or in combination with oxygen-nitrous oxide mixtures.
For induction of anaesthesia, inspired concentrations of up to 8% Sevoflurane usually require 2-3 minutes of anaesthesia in less than two minutes in both adults and children.

Maintenance:

Surgical levels of anaesthesia may be sustained with concentrations of 0.5 - 3% Sevoflurane with or without the concomitant use of nitrous oxide.

Emergence:

Emergence times are generally short following Sevoflurane anaesthesia. Therefore, patients may require early post-operative pain relief.

Older People:

MAC decreases with increasing age. The average concentration of Sevoflurane to achieve MAC in an 80 year old is approximately 50% of that required in a 20 year old.

Paediatric population:

Refer to Table 1 for MAC values for paediatric patients according to age.

Contra-indications:

Sevoflurane should not be used in patients with known or suspected sensitivity to Sevoflurane or other halogenated anaesthetics (e.g. history of liver function disorder, severe leucocytosis of unknown cause after anaesthesia with one of these agents).

Sevoflurane is also contraindicated in patients with known or suspected genetic susceptibility to malignant hyperthermia.

Sevoflurane is contraindicated in patients in whom general anaesthesia is contraindicated.

Warnings and Precautions:

Sevoflurane may cause respiratory depression, which may be augmented by narcotic premedication or other agents causing respiratory depression. Respiration should be supported if necessary. Hypotension and circulatory resuscitation may be necessary.

Sevoflurane should be administered only by persons trained in the administration of general anaesthesia.

Facilities for maintenance of a patent airway, artificial ventilation and oxygenation and circulatory resuscitation must be immediately available.
The concentration of Sevoflurane being delivered from a vapouriser must be known exactly. As volatile anaesthetics are flammable, the vapouriser should be specifically calibrated for Sevoflurane must be used. The administration of general anaesthesia must be individualised according to the patient's response. Hypotension and respiratory depression increase as anaesthesia is deepened.

In susceptible individuals, potent inhalation anaesthetic agents may trigger a skeletal muscle hypermetabolic state leading to high oxygen demand and the clinical syndrome known as malignant hyperthermia. The clinical syndrome is signalled by hypercapnia, and may include muscle rigidity, tachycardia, tachypnoea, cyanosis, arrhythmias, and/or unstable blood pressure. The appearance of these specific signs may also appear during light anaesthesia, acute hypoxia, hypercapnia and hypovolaemia. In clinical trials, one case of malignant hyperthermia was reported. In addition, there have been postmarketing reports of malignant hyperthermia. Some of these reports have been fatal.

Treatment includes discontinuation of triggering agents (e.g. Sevoflurane), administration of intravenous dantrolene sodium (consult prescribing information for intravenous dantrolene sodium for additional information on patient management), and supportive care. Electromyography. Such therapy includes vigorous efforts to restore body temperature to normal, respiratory and circulatory support as indicated, and administration of electrolyte and acid-base abnormalities. Renal failure may appear later, and urine flow should be monitored and sustained if possible.

Use of inhaled anaesthetic agents has been associated with rare increases in serum potassium levels that have resulted in cardiac arrhythmias and death in paediatric patients during the postoperative period.
Patients with latent as well as overt neuromuscular dis-

ease, particularly Duchenne muscular dystrophy, appear to be most vulnerable. Concomitant use of succinylcholine has been associated with most, but not all, of these cases. The use of succinylcholine may also lead to increases in serum creatine kinase levels and, in some cases, changes in urine consistent with myoglobinuria. Despite the similarity of the clinical picture, hypokalaemia and rhabdomyolysis of these patients exhibited signs or symptoms of muscle rigidity or hypermetabolic state. Early and aggressive intervention to treat the hyperkalaemia and resistant arrhythmias is recommended, as is subsequent evaluation for latent neuromuscular disease.

Isolated reports of QT prolongation, very rarely associated with torsade de pointes (in exceptional cases, fatal), have been received. Caution should be exercised when administering Sevoflurane to susceptible patients.

Isolated cases of ventricular arrhythmia were reported in paediatric patients with congenital long QT syndrome. Caution should be exercised in administering general anaesthesia, including Sevoflurane, to patients with mitochondrial disorders.

Very rare cases of mild to moderate and severe post-operative hepatic dysfunction or hepatitis with or without jaundice have been reported from postmarketing experiences. Clinical judgment should be exercised when Sevoflurane is used in patients with underlying hepatic dysfunction or under treatment with drugs known to cause hepatic dysfunction (see Side Effects).

Patients with repeated exposures to halogenated hydrocarbons, including Sevoflurane, within a relatively short interval may have an increased risk of hepatic injury. During the maintenance of anaesthesia, increasing the concentration of Sevoflurane produces dose-dependent increases in blood pressure. Excessive haemodynamic pressure may be related to depth of anaesthesia and in such instances may be corrected by decreasing the inspired concentration. Excessive increases in blood pressure may be taken when selecting the dosage for patients who are hypovolemic, hypotensive, or otherwise haemodynamically compromised, e.g., due to concomitant medications.

As with all anaesthetics, maintenance of haemodynamic stability is important to avoid myocardial ischaemia in patients with coronary artery disease.

Caution should be observed when using Sevoflurane during anaesthesia at risk from elevated intra-cranial pressure on the uterus could increase the risk of uterine bleeding (see Use in pregnancy and lactation).

The recovery from general anaesthesia should be known exactly. Patients who are discharged from the recovery room. Rapid emergence is generally seen so early relief of post-operative pain may be required. The physical recovery of patients from Sevoflurane administration generally occurs within minutes, the impact on intellectual function for two or three days following anaesthesia has not been studied.

As with other anaesthetics, changes in moods may persist for several days following administration (see Effects on driving ability and operation of machinery). Residual effects on the patient may be associated with agitation and lack of co-operation about 25% of cases.

Replacement of Desiccated CO₂ Absorbents:

Rare cases of extreme heat, smoke, and/or spontaneous fire in the anaesthesia machine have been reported during use of desiccated CO₂ absorbents. The use of desiccated CO₂ absorbent, specifically those containing potassium hydroxide (e.g. Baralyme). An unusually delayed rise or unexpected decline of inspired Sevoflurane concentration (monitored via vapouriser) may be associated with an excessive heating of the CO₂ absorbent canister. An exothermic reaction, enhanced Sevoflurane degradation, and the formation of carbon monoxide and carbon dioxide, can occur when the CO₂ absorbent becomes desiccated, such as after an extended period of dry gas flow through the CO₂ absorbent canisters. Sevoflurane degradants (monitored via vapouriser) may be associated with compounds A, B, C, and D) were observed in the respiratory circuit of an experimental anaesthesia machine using desiccated CO₂ absorbents. Sevoflurane degradation concentrations (8%) for extended periods of time (≥ 2 hours). Concentrations of formaldehyde observed at the anaesthesia respiratory circuit (using sodium hydroxide contain-

ing absorbents) were consistent with levels known to cause mild respiratory irritation. The clinical relevance of the degradants observed under this extreme experimental condition is not known.
If a health care professional suspects that the CO₂ absorbent has become desiccated, it must be replaced before use. The use of volatile anaesthetics (such as Sevoflurane) must be taken into account that the colour indicator does not always change after desiccation has taken place. Therefore, the lack of significant colour change should not be taken as an assurance of adequate hydration. CO₂ absorbents should be replaced routinely regardless of the state of the colour indicator.

Renal Impairment:

Because of the small number of patients with renal insufficiency (baseline serum creatinine greater than 1.5mg/dl), studied, the safety of Sevoflurane administration in this group has not been fully established. Therefore, Sevoflurane should be used with caution in patients with renal insufficiency.

In some studies in rats, nephrotoxicity was seen in animals exposed to levels of Compound A (pentaffluoroisopropyl fluoromethyl ether) (PIF) in excess of those usually seen in routine clinical practice. The mechanism of this renal toxicity in rats is unknown and its relevance to man has not been established.

Neurosurgery & Neuromuscular Impairment:

Sevoflurane should be administered cautiously in conjunction with techniques to lower intra-cranial pressure (e.g. hyperventilation).

Seizures:

Seizures of a patient have been reported in association with Sevoflurane use.

Use of Sevoflurane has been associated with seizures occurring in children and young adults as well as older adults with and without preexisting risk factors. Clinical judgment is necessary before Sevoflurane is used in patients at risk of seizures. In children the depth of anaesthesia should be limited. EEG may permit the optimization of Sevoflurane dose and help avoid the development of seizure activity in fragile patients (see Side Effects-Paediatric population).

Paediatric population:

As with Sevoflurane has been associated with seizures. Many have occurred in children and young adults starting from 2 months of age, most of whom had no predisposing risk factors. Clinical judgment should be exercised when using Sevoflurane in children and young adults at risk for seizures (see Warnings and Precautions - Seizures). Dystonic movements in children have been observed (see Side Effects).

Interactions:

Beta-sympathomimetic agents like isoprenaline and alpha- and beta-sympathomimetic agents like adrenaline and noradrenaline should be used with caution during Sevoflurane narcosis, due to a potential risk of ventricular arrhythmia.

Non-selective MAO-inhibitors: Risk of crisis during the induction. It is generally recommended that treatment with MAO-inhibitors be stopped 2 weeks before surgery. Sevoflurane may lead to marked hypotension in patients treated with calcium antagonists, in particular dihydropyridine derivatives.

Caution should be exercised when calcium antagonists are used concomitantly with inhalation anaesthetics due to the risk of additive negative inotropic effect.

Concomitant use of succinylcholine with inhaled anaesthetics and succinylcholine are similar to those seen with potassium levels that have resulted in cardiac arrhythmias and death in pediatric patients during the post-operative period.

Sevoflurane has been shown to be safe and effective when administered concurrently with a wide variety of agents commonly encountered in surgical situations such as central nervous system agents, sedatives, anaesthetics, anaesthetics, hormones and synthetic substitutes, blood derivatives and cardiovascular drugs, including epinephrine

Epinephrine/Adrenaline

Sevoflurane is similar to isoflurane in the sensitisation of the myocardium to the arrhythmogenic effect of exogenous catecholamines.

Indirect-acting sympathomimetics

There is a risk of acute hypertensive episode with the concomitant use of Sevoflurane and indirect-acting sympathomimetics products (amphetamines, ephedrine).

Beta blockers

Sevoflurane may increase the negative inotropic, chronotropic and dromotropic effects of beta blockers (by blocking cardiovascular compensatory mechanisms).

Verapamil

Impairment of atrioventricular conduction was observed when verapamil and Sevoflurane were administered at the same time.

Inducers of CPY2E1

Medicinal products and compounds that increase the activity of cytochrome P450 isoenzyme CPY2E1, such as isoniazid and alcohol, may increase the metabolism of Sevoflurane and lead to significant increases in plasma fluoride concentrations. Concomitant use of Sevoflurane and isoniazid can potentiate the hepatotoxic effects of isoniazid.

St John's Wort

Severe hypotension and delayed emergence from anaesthesia with halogenated inhalational anaesthetics have been reported in patients treated long-term with St John's Wort.

Barbiturates

Sevoflurane administration is compatible with barbiturates as commonly used in surgical practice.

Benzodiazepines and Opioids

Benzodiazepines and opioids are expected to decrease the MAC of Sevoflurane in the same manner as with other inhalational anaesthetics. Sevoflurane administration is compatible with benzodiazepines and opioids as commonly used in surgical practice. Opioids such as alfentanil and sufentanil, when combined with Sevoflurane, may lead to a synergistic fall in heart rate, blood pressure and respiratory rate.

Nitrous Oxide

As with other halogenated volatile anaesthetics, the MAC of Sevoflurane is decreased when administered in combination with nitrous oxide. The MAC equivalent of nitrous oxide is approximately 50% in adult and approximately 25% in paediatric patients (see Posology and Method of Administration - Maintenance).

Neuromuscular Blocking Agents

As with other halogenated volatile anaesthetics, Sevoflurane affects both the intensity and duration of neuromuscular blockade by non-depolarising muscle relaxants. When used to supplement alfentanil-N₂O anaesthesia, Sevoflurane potentiates neuromuscular block induced with pancuronium, vecuronium or atracurium. The dosage adjustments for these muscle relaxants when administered with Sevoflurane are similar to those required with isoflurane. The effect of Sevoflurane on succinylcholine and the duration of depolarising neuromuscular blockade has not been studied.

Caution in reduction of neuromuscular blocking agents during induction of anaesthesia may result in delayed onset of conditions suitable for endotracheal intubation or inadequate muscle relaxation because potentiation of neuromuscular blockade is observed a few minutes after the beginning of Sevoflurane administration.

Among non-depolarising agents, vecuronium, pancuronium and atracurium interactions have been studied. In the case of vecuronium, the onset of blockade is possible in the (1) For endotracheal intubation, do not reduce the dose of non-depolarising muscle relaxants; and (2) During maintenance of anaesthesia, the dose of nondepolarising muscle relaxants should be reduced compared to that during N₂O/O₂ anaesthesia.

Administration of supplemental doses of muscle relaxants should be guided by the response to nerve stimulation.

As with other agents, lesser concentrations of Sevoflurane may be required following use of an intravenous anaesthetic e.g. propofol.

Significant increases in plasma fluoride concentrations have been observed following the increased activity of CPY2E1.

Use in fertility, pregnancy and lactation:

Pregnancy

Sevoflurane has a relaxant effect on the uterus, which can lead to increased uterine bleeding, as was reported in a study of its use during termination of pregnancy. Use during labour and delivery is limited to one study by a caesarean section.

Reproduction studies in rats and rabbits at doses up to 1 MAC have revealed no evidence of harm to the fetus due to Sevoflurane. There are no adequate and well-controlled studies in pregnant women; therefore, Sevoflurane should be used during pregnancy only if clearly needed.

Labour and Delivery

In a clinical trial, the safety of Sevoflurane was demonstrated in healthy term infants when used for anaesthesia during caesarean section. The safety of Sevoflurane in labour and vaginal delivery has not been demonstrated.

Breastfeeding

It is not known whether Sevoflurane or its metabolites are excreted in human milk. Due to the absence of documented experience, women should be advised to skip breast-feeding for 48 hours after administration of Sevoflurane and discard milk produced during this period.

Fertility

Reproduction studies in rats and rabbits at doses up to 1 MAC have revealed no evidence of impaired fertility due to Sevoflurane.

Effects on driving ability and operation of machinery:

As with other anaesthetic agents, patients should be advised that performance of activities requiring mental alertness, such as operating a motor vehicle or hazardous machinery, may be impaired for some time after general anaesthesia (see Warnings and Precautions).

Patients should not be allowed to drive for a suitable period after Sevoflurane anaesthesia.

Side Effects:

Summary of the safety profile
The use of Sevoflurane as an anaesthetic agent, Sevoflurane may cause dose-dependent cardio-respiratory depression. Most adverse reactions are mild to moderate in severity and transient. Nausea, vomiting and delirium are commonly observed in the post-operative period. There is a similar incidence to those found with other inhalation anaesthetics. These effects are common sequelae of surgery and general anaesthesia (see Warnings and Precautions). In addition, other agents administered intra-operatively or post-operatively and to the patient's response to the surgical stimulus.

The most commonly reported adverse reactions were as follows:

In adult patients: hypotension, nausea and vomiting; In elderly patients: bradycardia, hypotension and nausea;

In paediatric patients: agitation, cough, vomiting and nausea.

Tabulated summary of adverse reactions

All adverse reactions at least possibly related to Sevoflurane from clinical trials and post-marketing experience, are presented in the following table by MedDRA System Organ Class, Preferred Term frequency. The following frequency categories are used: Very common (>1/10); common (>1/100, <1/10); uncommon (>1/1,000, <1/100); rare (>1/10,000, <1/1,000); very rare (<1/10,000) including isolated reports. Post-marketing adverse reactions are reported voluntarily from a population with an unknown rate of exposure. Therefore it is not possible to estimate the true incidence of adverse events and the frequency is "unknown". The type, severity and frequency of adverse reactions in Sevoflurane patients in clinical trials were comparable to adverse reactions in reference drug patients.

- decreased blood pressure (hypotension)
- cough
- nausea
- vomiting

Common frequency:

- drowsiness (somnolence)
- dizziness
- increased blood pressure (hypertension)
- headache
- fast heart rate (tachycardia)
- slow shallow breathing (respiratory depression)
- watering mouth (salivary hypersecretion)
- chills
- fever (pyrexia)
- low body temperature (hypothermia)
- abnormal sugar (glucose) level
- abnormal liver function test*
- white blood cell count abnormal
- blood fluoride increased**
- delirium

Uncommon frequency:

- a decrease or increase in the number of certain white blood cells. A decrease in the number of white blood cells may be associated with dizziness, fatigue, weakness, mouth ulcers and a tendency towards infections.
- confusion
- abnormal heart rhythm
- pauses in breathing
- inadequate amount of oxygen
- asthma
- difficulty in passing urine
- glucose in the urine***
- abnormal kidney function test*

Unkown frequency:

- convulsions (fits), particularly in children
- twitching and jerking movements
- fluid in the lungs
- inflammation or damage to the liver. People with liver disease may have abdominal pain or fullness, dark urine, pale or white-coloured stool, fatigue, general itching, yellowing of the eyes, nausea and vomiting
- kidney failure. People with kidney disease may have tiredness, swelling or puffiness in the face, abdomen, thighs or ankles, passing less urine or problems urinating and back pain
- skin rashes
- heart arrhythmia (irregular heartbeats or abnormal heart rhythm) known as QT prolongation

*If you have a blood test, you may be told that you have changes in your liver or kidney enzymes or other products found in the blood. These will not normally cause any symptoms.

**Levels of fluoride in the blood may be raised slightly during and immediately after anaesthesia, due to the body breaking down Sevoflurane, but these levels are not believed to be harmful and soon return to normal.

*** If you have a urine test you may be told that you have glucose in your urine. You may not have any symptoms. There have been very rare reports of cardiac arrest, a condition where the heart stops beating.

After surgery, some children may have irregular heart rhythms, which can potentially be life-threatening, due to changes in blood potassium levels.

Children with Pompe's disease, a disease that they are born with, may have irregular heart rhythm during anaesthesia with Sevoflurane.

After receiving Sevoflurane

You will come round or wake up within a few minutes. Children in particular, may be restless on awakening. Tell your doctor or anaesthetist if you need additional pain relief. If you have any other unusual or unexpected symptoms after receiving Sevoflurane anaesthesia, tell your ward doctor or anaesthetist immediately.

If you have any questions about Sevoflurane which are not answered by this leaflet, ask your ward doctor or anaesthetist.

5. How should Sevoflurane be stored?

Sevoflurane should be stored in a tightly closed container **NOT** above 25°C. Do not refrigerate. Do **NOT** use after the expiry date printed on the packaging.

6. Further information about Sevoflurane

Sevoflurane ingredients:

The active ingredient is Sevoflurane. Water is also present to provide the Sevoflurane with protection from substances that can cause its breakdown (environmental Lewis acids).

Marketing Authorisation and Manufacturer's Details

Marketing Authorisation Holder:

AbbVie Ltd
Abbott House, Vanwall Road, Maidenhead
Berkshire SL6 4XE, UK

Manufacturer:

Asesica Queenborough Ltd.,
Queenborough, Kent, ME11 5EL, UK

To report any side effect(s):

In Bahrain, United Arab Emirates, Yemen, Kuwait, Oman, and Qatar:

- o Hotline: +971 56 413 5746
- o Email: pv.gulf@abbvie.com

In Iraq, Jordan, Lebanon, Syria, and Iran:

- o Hotline: +961 70122346
- o Email: Pharmscogilance_levant@abbvie.com

This leaflet was last updated in October 2014

This is a Medicament

- Medicament is a product which affects your health and its consumption contrary to instructions is dangerous for you.
- Follow strictly the doctor's prescription, the method of use and the instructions of the pharmacist who sold the medicament.
- The doctor and the pharmacist are the experts in medicines, their benefits and risks.
- Do not by yourself interrupt the period of treatment prescribed for you.
- Do not repeat the same prescription without consulting your doctor.
- Keep all medicaments out of reach of children.

Council of Arab Health Ministries
Union of Arab Pharmacists

Adverse Reaction Data Derived From Clinical Trials and Post-marketing Experience

Summary of Most Frequent Adverse Drug Reactions in Sevoflurane Clinical Trials and Post-marketing Experience

System Organ Class	Frequency	Adverse Reactions
Immune system disorders	Unknown	Anaphylactic reaction 1 Anaphylactoid reaction Hypersensitivity 1
Blood and lymphatic system disorders	Uncommon	Leukopenia Leukocytosis
Psychiatric disorders	Very Common Uncommon	Agitation Confusional state
Nervous system disorders	Common	Somnolence Dizziness Headache Convulsion 2, 3 Dystonia
Cardiac disorders	Very Common Common Uncommon	Bradycardia Tachycardia Atrioventricular block complete Atrial fibrillation Arrhythmia Ventricular extrasystoles Supraventricular extrasystoles Extrasystoles Cardiac arrest 4 QT prolongation associated with Torsade
Vascular disorders	Very Common Common	Hypertension Hypertension
Respiratory, thoracic and mediastinal disorders	Very Common Common	Cough Respiratory disorder Laryngospasm
	Uncommon	Apnoea Hypoxia Asthma Bronchospasm Dyspnoea 1 Wheezing 1 Pulmonary oedema
	Unknown	
Gastrointestinal disorders	Very Common	Nausea Vomiting Salivary hypersecretion
Renal and urinary disorders	Uncommon Unknown	Urinary retention Glycosuria Renal failure acute
Hepato-biliary disorders	Unknown	Hepatitis 1, 2 Hepatic failure 1, 2 Hepatic necrosis 1, 2
Skin and subcutaneous tissue disorders	Unknown	Dermatitis contact 1 Pruritus Rash 1 Swelling face 1 Urticaria
Musculoskeletal and connective tissue disorders	Unknown	Muscle twitching
General disorders and administration site conditions	Common Unknown	Chills Pyrexia Hypothermia Chest discomfort 1 Hyperthermia malignant 1, 2
Investigations	Common	Blood glucose abnormal Liver function test abnormal 5 White blood cell count abnormal Aspartate aminotransferase increased Blood fluoride increased 6
	Uncommon	Alanine aminotransferase increased Blood creatinine increased Blood lactate dehydrogenase increased
Injury, poisoning and procedural complications	Common	Hypothermia

1 See section **Side Effects – Description of selected adverse reactions.**

2 See section **Warnings and Precautions.**

3 See section **Side Effects – Paediatric population.**