# Effects of Propofol Versus Sevoflurane on Outpatient Pediatric Surgery

**Mustafa Othman Abd Alsalam AlKhazimi, Zeinab Ibrahim Ahmed El-Hossary, Hosam Mohamed Soliman, Hatem Ahmed Nazmi Mohammed**

Department of Anesthesia, Intensive Care and Pain management, Faculty of Medicine, Zagazig University, Egypt

**Corresponding author:** Mustafa Othman Abd Alsalam AlKhazimi

**E-mail:** elkhazmi03@gmail.com

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**Abstract:**

The rate of ambulatory surgery has increased steadily due to continued improvements in anesthesia techniques, such as regional anesthesia, and the availability of short-acting anesthetics with reduced side effects and has also be increased as a result of more appropriate ambulatory discharge criteria and minimally invasive surgical methods. Propofol and sevoflurane are the most used anesthetics in pediatric surgery. So, we aimed to study their uses in Outpatient Surgery in Pediatrics.

**Keywords:** Propofol, Sevoflurane, Surgery, Pediatrics.

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## Introduction:

Outpatients surgery means a day case surgery in Great Britain and Ireland is clear; the patient is admitted and discharged on the same day, with day surgery as the intended management[1].

Surgical day cases are often viewed as the highest impact change in healthcare to improve productivity; healthcare guidelines have previously advised for a target of "treating day surgery [rather than inpatient surgery] as the norm for elective surgery" [1].

**The advantages of day case surgery are[2]:**

- Shorter inpatient stays
- Reduced risk of hospital acquired infection
- Reduced waiting lists
- Reduced hospital costs
- Reduced demand for inpatient beds

The main advantages of day surgery are cost control, early patient activity, less pain caused by minimally invasive surgical techniques, early return of patients to the home environment, reduced risk of cross-infection in the hospital, and fewer wage losses due to early return. Under the background of making good use of resources, due to the advancement of anesthesia technology and the development of surgical technology, you can quickly and smoothly resume work. The disadvantage of day care surgery is that it cannot be performed on all patients and all surgical operations, because day care surgery requires high surgical applicability, unexpected readmissions, more operating rooms, and higher skills of health personnel[(3)].

A One of the most crucial factors for pediatric patients is age: a combination of gestational and post-natal age is used to assess the relative risk for apnea and, consequently, the requirement for ongoing monitoring after general anesthesia. Appropriate patient and procedure selection are crucial for patients and vary by specific age parameters[(4)].

Prior to surgery, patients with acute illnesses such upper respiratory infections or gastrointestinal infections should be healthy for a while; recent hospitalizations or emergency room (ER) visits must be examined for cardiovascular conditions that would make anesthesia impossible. It is important to check on patients who have bleeding disorders to make sure that outpatient surgery won't put them at danger for their specific condition. After assessment, candidates with a body mass index (BMI) above 95% but below 99% can qualify for outpatient surgery. After assessment, some adenoidectomy patients under the age of two may be qualified for outpatient surgery[(5)].

The majority of studies showing the effectiveness of same-day discharge protocols highlight the necessity of a multidisciplinary effort involving nurses and healthcare professionals from various hospital departments, including the emergency room, surgical services, anesthesiology, and the post-anesthesia care unit. Also, during the implementation phase, the inclusion criteria should be reviewed and communicated. These criteria should clearly state the time of day, patient selection, diagnoses, and intra-operative results. Excellent patient and provider satisfaction is also achieved through careful patient selection and process implementation .It is obvious that the outpatient surgery patients are a select group of the healthiest patients given the numerous relevant contraindications[(6)].

**Complication:**

**Postoperative Pain:**

Pain, as defined by International Association for Study of Pain, is an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage. The multimodal approach to pain management involving cognitive, behavioural, physical, and pharmacological interventions is required for effective pain control and should be provided to all children, even for minor painful procedures to prevent the development of fear and anxiety. A careful assessment of the severity of pain using various age-specific pain scoring systems is essential for providing effective analgesia in pediatric patients[7].

**Delirium and Agitation:**

Emergence agitation seen in postoperative period is characterized by hyperactive psychomotor and aberrant cognitive behaviours following general anesthesia. It should be documented as a 'vital sign' in postoperative records. Patients anxiety, temperament, and behaviours are some of the important factors predicting emergency delirium[8] .

These children have 1.43 times greater risk of developing maladaptive behavioural change and physical aggression resulting in self-extubation, accidental removal of intravenous catheters, and parental distress[9].

Postoperative disorientation and agitation may be caused due to pain, hypoxia, hypotension, hypocarbia, hypercarbia, hypoglycemia, hypothermia, full bladder, and raised intracranial pressure. Clinically, ED is characterized with the presence of no eye contact, no purposeful action, and no awareness of surroundings[10].

Many scales have been designed to recognize the severity of ED. In Pediatric Anesthesia Emergence Delirium (PAED) scale, the scores for each of the five listed behaviours (eye contact, purposeful movements, awareness of surroundings, restlessness, and inconsolability) are added to achieve a total score (maximum score of 20). Score $\geq$10 has 64% sensitivity and 86% specificity, and score >12 has 100% sensitivity and 94.5% specificity for diagnosing ED[11] .

**Airway related complications:**

Their incidence is 60% of all anesthesia-related complications. The common causes of postoperative hypoxemia are residual effect of anesthetics, inadequate reversal neuromuscular blocker, respiratory depression, airway obstruction, laryngospasm, bronchospasm, and postoperative stridor. The acceptable lower limit of $PaO_2$ is 80–100 mmHg in the recovery room, and it corresponds to $spO_2$ 93–97%. Oxygen therapy with a face mask should be initiated when oxygen saturation falls below 93%. It is dangerous to delay treatment of laryngospasm as it can lead to postoperative pulmonary oedema, hypoxic sequelae, respiratory insufficiency, and cardiac arrest. The airway obstruction seen post extubation can be relieved with neck extension, jaw thrust, and by placing the child in a lateral position[12].

Upper airway obstruction should be treated with high flow nebulised oxygen with racemic epinephrine (0.5 ml of 2% solution diluted to 2–4 ml given every 4 hrs). It produces vasoconstriction and minimizes tissue oedema. Racemic epinephrine is the choice due to its few side effects than the levorotatory form of adrenaline . Laryngospasm can be managed by, administration of 100% oxygen, continuous positive airway pressure, and suppressing the laryngeal reflex with sub hypnotic dose of propofol (0.8 mg/kg). Gold standard is administration of IV succinylcholine 1 mg/kg with atropine 0.2 mg/kg in the presence of bradycardia. Bronchospasm managed by magnesium sulphate before or after the administration of bronchodilators, it helps to relax the bronchial musculature. Dexamethasone 0.5 mg/kg 6 hourly for 4–6 doses is commonly used. Some cases might need intubation and ventilation[13].

**Hypothermia:**

Children are more prone to hypothermia because of the lack of fat insulation, excessive heat loss due to the increased surface area to weight ratio, and the presence of few brown fat cells. Preventive measures are warming the operation theatre up to 26°C, using a radiant heater at induction and recovery, covering the babies with cotton pads, and infusion of warm fluids[14].

**Propofol"**

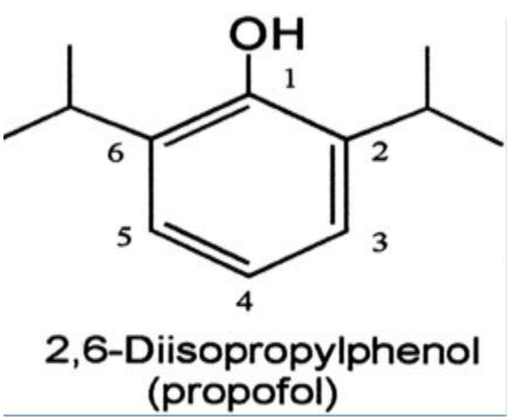


**Fig. (1):** Chemical structure of propofol, 2,6-diisopropylphenol[15]

Propofol, marketed as Diprivan, among other names, also known as 2,6-Diisopropylphenol, is a short-acting medication that results in a decreased level of consciousness and a lack of memory for events. Its uses include the induction and maintenance of general anesthesia, sedation for mechanically ventilated adults, and procedural sedation. It is also used for status epilepticus if other medications have not worked. It is given intravenous injection or infusion, and the maximum effect takes about two minutes to occur and typically lasts five to ten minutes[16].

**Mechanism of Action:**

The mechanism of action for propofol is related to the effects on gamma-aminobutyric acid (GABA) -mediated chloride channels in the brain. Propofol may work by decreasing the dissociation of GABA from GABA receptors in the brain and potentiating the inhibitory effects of the neurotransmitter. This, in turn, keeps the channel activated for a longer duration resulting in an increase in chloride conductance across the neuron, causing a hyper-polarization of the cell membrane, making it harder for a successful action potential to fire[17].

**Pharmacodynamics (PD):**

**Cardiovascular System:**

Propofol has extensive effects on the cardiovascular system. The most prominent effect is systemic blood pressure reduction accompanied by a decrease in cardiac output, decrease in heart rate and induce rhythms. This effect is dose-dependent and even occurs at sedative doses. It is more pronounced in elderly and compromised patients. The effect is mediated by a significant decrease of sympathetic tone accompanied by a decrease in vascular resistance. Furthermore, propofol also inhibits the physiological baroreflex responses, thereby enhancing cardiovascular depression[18].

**Respiratory System:**

Propofol is a potent ventilatory central depressant. It interferes with ventilation in a dose-dependent manner by affecting central chemoreceptor sensitivity, it decrease tidal volume, decrease respiratory rate, reducing ventilatory responses to hypercapnia and hypoxia. In higher doses, propofol causes apnea. Furthermore, it attenuates vagal- and methacholine-induced bronchoconstriction and potentiates hypoxic pulmonary vasoconstriction[19].

**Central nervous system:**

Propofol decreases cerebral blood flow, intracranial pressure, and cerebral metabolic rate, while maintaining dynamic and static autoregulation and vascular responsiveness to carbon dioxide. These favourable effects on cerebral physiology make propofol an almost ideal hypnotic for anesthesia during neurosurgery. The evidence for neuroprotective effects of propofol during ischemia-reperfusion injury is conflicting; however, its role as part of multimodal neuroprotection has been established[20].

**Sevoflurane:**

Sevoflurane is a halogenated inhalational anesthetic that is Food and Drug Administration (FDA) approved for the induction and maintenance of general anesthesia in adults and pediatric patients for inpatient and outpatient surgery. Sevoflurane is a volatile anesthetic that provides hypnosis, amnesia, analgesia, akinesia, and autonomic blockade during surgical and procedural interventions[21].

Sevoflurane was approved for use by the Food and Drug Administration (FDA) in 1995[22].

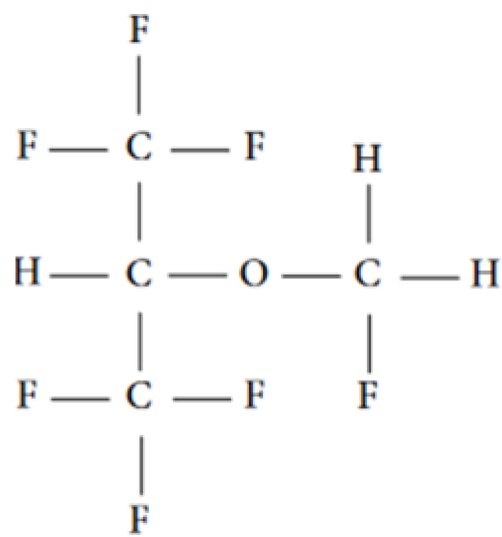


**Fig. (2):** Structures of sevoflurane[23].

Minimum alveolar concentration (MAC) values of sevoflurane decrease with age, from 3.3% in neonates and 2.5% in infants and young adults to 1.58% to 2.05%

in middle-aged adults and 1.45% in adults who are more than 70 years old[24].

**Mechanism of Action**

Like other halogenated inhalational anesthetics, sevoflurane's precise mechanism to induce and maintain general anesthesia is unknown. There have been multiple attempts to identify a unitary hypothesis. However, no single proposed mechanism of action has fully explained their clinical effects. A current working hypothesis is that inhaled anesthetics enhance inhibitory postsynaptic channel activity (gamma-aminobutyric acid (GABA) and glycine) and inhibit excitatory synaptic channel activity (N-methyl-D-aspartate (NMDA), nicotinic acetylcholine, serotonin, and glutamate) in the central nervous system[25].

**Pharmacodynamics:**

Like the effects of other anesthetic agents, those of sevoflurane on the vital systems are mostly depressant.

**Respiration:**

A decrease in ventilation leading to apnea at concentrations of between 1.5 and 2.0 MAC can be observed. The ventilatory depression with sevoflurane is the result of a combination of central depression of medullary respiratory neurons and depression of diaphragmatic function and contractility[26].

**Circulation:**

Sevoflurane decreases blood pressure in a dose-dependent manner by decreasing systemic peripheral resistance. At clinically relevant contrations, cardiac output is usually preserved. Heart rate remains unchanged or even decreases. Coronary blood flow remains preserved and regional blood flow to other vascular beds appears to be maintained at least when systemic hemodynamics are preserved. For sevoflurane (unlike for desflurane), no sympathetic nervous system activation is observed. Although sevoflurane has been reported to prolong the QT and the QTc interval, it has no effect on the normal cardiac conduction pathways and therefore is considered a safe agent that can also be used in cardiac electrophysiological procedures[27].

**Central nervous system:**

Sevoflurane is a cerebral vasodilator. In neurosurgical patients, sevoflurane decreased middle cerebral artery flow velocity and caused no epileptiform electroencephalogram activity and no increase of intracranial pressure and reduce the cerebral metabolic rate. Cerebral autoregulation is maintained at low concentrations of sevoflurane, but higher doses seem to decrease autoregulatory capacity[28].

**Administration:**

Sevoflurane is an inhaled halogenated anesthetic delivered via a sevoflurane-specific calibrated vaporizer attached to an anesthesia machine. Sevoflurane is delivered via the lungs as a volume percent of inspired gas[29].

## Conclusion:

We can conclude that the children who received propofol anesthesia had the lower risks of emergence agitation, postoperative nausea and vomiting and postoperative pain when compared with sevoflurane anesthesia. Propofol regimen was the more peaceful recovery approach with less perioperative respiratory complications than sevoflurane-based anesthesia in infants undergoing outpatients surgery

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