

Anaphylaxis Treatment in Anesthesia

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Patients are exposed to a variety of medications, intravenous fluids, and latex in the operating room. Anaphylaxis or type I hypersensitivity reaction can present during anesthesia as skin redness/rash, bronchospasm, laryngospasm, hypotension, or circulatory collapse. The condition can be life-threatening. Preoperative assessment of allergies, asthma, allergy testing (if possible), prompt diagnosis during anesthesia, and rapid management of the condition are essential to prevent adverse outcomes.



Incidence

There is significant variation in the reporting of incidences of [anaphylactic reactions](#) during surgery. This variation is due to the **difficulty in reporting** the total number of cases undergoing anesthesia as well as to the **difficulties in diagnosing** anesthesia-related anaphylaxis. The incidence rate is reported to vary from **1 in 4,000 to 1 in 20,000 cases**, with **more women than men** affected.

Pathogenesis

Anaphylaxis means “against protection” and usually occurs when an individual is **re-exposed to an antigen**. An anaphylactic reaction is a **type I hypersensitivity reaction** in which **IgE** is released from **mast cells** and **basophils**. This process is followed by the release of inflammatory mediators such as **histamine, leukotrienes, bradykinin, and platelet-activating factor**.

Anaphylactoid reactions, though identical to anaphylaxis, are **not IgE dependent**. They occur due to **the non-immune mediated release of inflammatory mediators** from the mast cells or basophils, or due to **complement activation**.

Histamine, or a complement/bradykinin cascade, is initiated with the activation of **tyrosine kinase** and the influx of **calcium** into the mast cells and basophils, regardless of the initial antigen. This leads to the **release of histamine, tryptase, chymase, carboxypeptidase A3, and proteoglycans**. In addition, there is **activation of COXs, lipoxygenases, and phospholipase A2** and the **release of prostaglandins, leukotrienes, and platelet-activating factor**. Other cytokines, such as **IL-6, IL-33, and TNF-alpha**, are also released.

Gq/G11 mediate opening of the **vascular endothelial barrier**. Histamine, along with other vasodilators, causes **vasodilatation** with pooling of blood peripherally and increased vascular permeability. This in turn leads to **reduced systemic vascular resistance, hypovolemia, hypotension, and circulatory collapse**. Histamine also causes **bronchospasm**, while leukotrienes cause **peripheral airway spasm** leading to **airway obstruction, laryngeal edema, and asphyxiation** followed by **death**.

Anaphylaxis can also occur with the **first exposure to an antigen**. This is due to **cross-reactions** between various drugs and products administered in rapid succession, or to **latex allergy**. Adverse reactions to drugs used during anesthesia can be of two types:

- **Dose-dependent reactions** related to the drug's pharmacological properties or related to the drug's metabolites
- **Non-dose dependent reactions** unrelated to the drug's properties

Etiology

The causes of anaphylaxis during anesthesia include, in order of frequency:

- **Muscle relaxants:** Anaphylactic reactions due to muscle relaxants occur at a rate of 1 in 6,500 cases. Succinylcholine, atracurium, pancuronium, and vecuronium have been reported to cause these reactions.
- **Latex:** Polypeptides in latex are known to cause a direct IgE-mediated response, especially in susceptible individuals such as those with [spina bifida](#), congenital genitourinary anomalies, or spinal cord injuries.
- **Antibiotics:** Beta-lactams such as penicillin, cephalosporin, and sulfas are responsible for drug-related anaphylaxis. Vancomycin, which is used for prophylaxis, can cause "red man" syndrome. This condition is characterized by erythema of the upper body, pruritus, and hypotension.
- **NSAIDs:** Aspirin and other nonsteroidal anti-inflammatory drugs are associated with anaphylaxis as well as anaphylactoid reactions. They inhibit cyclooxygenase with excessive leukotrienes production and hypersensitivity symptoms within 10 minutes of intravenous administration, 30 minutes after rectal administration, and 60 minutes after oral administration.
- **Colloids:** Plasma volume expanders, or colloids, are responsible for approximately 4% of anaphylactic reactions in the operating room. Their effects are visible about 20 minutes after starting a colloid infusion and can be severe in approximately 20% of cases.
- **Other anesthetic drugs:** Thiopental has been reported to cause anaphylaxis in 1 of 30,000 patients, with women affected more than men. **Propofol** can stimulate the release of histamine directly, especially when administered with muscle relaxants. Amongst benzodiazepines, midazolam is known to be safer than diazepam. Narcotics, on the other hand, cause an anaphylactoid reaction, with flushing and urticaria.
- **Antiseptic solutions:** Povidone-iodine is associated with type IV

hypersensitivity and not type I reactions. Patients can become sensitized to chlorhexidine, as it is widely used. Chlorhexidine anaphylaxis can occur following cutaneous, mucosal, or even parenteral usage.

Diagnosis

Identifying the exact cause of an anaphylactic reaction **can be difficult**, as several drugs are often used in rapid succession during anesthesia. In addition, the patient is draped (and therefore not completely visible) and unable to vocalize discomfort. It is therefore the responsibility of the anesthetist, surgeon, and operating room personnel to watch for the following signs:

- **Skin:** urticaria, flushing, and facial edema (immediate reactions)
- **Cardiovascular system:** fall in blood pressure (hypotension) or tachycardia
- **Respiratory system:** difficulty in ventilation (bronchospasm/laryngospasm), [pulmonary edema](#), [hypoxia](#).

The most common signs are **flushing, difficulty ventilating** the patient, and a rapid **fall in blood pressure**.

Management

1. As soon as anaphylactic/anaphylactoid signs are noticed, the **suspected drug infusion should be discontinued**.
2. The patient should be **ventilated with 100% oxygen**.
3. The patient should be **laid flat**, and the **end of the operating table should be elevated**.
4. **Intramuscular epinephrine** should be administered and can be repeated if necessary.
5. **Bronchodilators** should be administered to relieve bronchospasm.
6. **Antihistamines and corticosteroids** can also be administered.

Prevention

1. A detailed patient history should be taken prior to surgery.
2. A **skin/prick test/patch test/intradermal test** to determine the presence of allergies prior to scheduling surgery should be performed on all patients with a suspected **history of allergies**.
3. **Alternative drugs or products** should be used if there is a known history of allergy.

References

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