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Tracheal Intubation, Significance Of Vecuronium For Tracheal Intubation

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ABSTRACT

Endotracheal intubation is the integral part and holds a paramount importance in anesthesia. To facilitate the intubation Succinylcholine is most preferred, which is a depolarizing muscle relaxant, it serves many advantages besides these benefits it has several side effects which are bradycardia, dysrhythmias , increased released in potassium, and triggering malignant hyperthermia. Muscle relaxants are pivotal in Endotracheal intubation by inducing a sequenced temporary paralysis of muscles , which further and Alternatively facilitates the easy insertion of tube .Instead of succinylcholine, the most preferred agents are Rocuronium and Vecuronium which are from the class of non depolarising muscle relaxants . These agents are employed for their longer lasting effects and reduced side effects compared to succinylcholine. By gaining muscle relaxation these agents aid in achieving optimal conditions for successful and secured Endotracheal intubation while minimizing patients discomfort and potential complications associated with airway manipulation.

A comparative study between vecuronium and rocuronium enables investigation into neuromuscular blocking agents efficacy and safety profiles. This study aims to discern the nuances between these two agents in terms of various clinical scenarios.

Keywords.

Endotracheal intubation[1], neuromuscular blocking agents[2], succinylcholine[3], rocuronium[4], vecuronium[5], muscle relaxation[6], anaesthesia[7], surgery[8], airway management[9], ventilation[10], complications[11].

Introduction.

Tracheal intubation is a medical procedure used to establish and maintain an open airway in patients who are unable to breathe adequately on their own. It involves inserting a flexible tube, known as an endotracheal tube, into the windpipe (trachea) through the mouth or nose. This tube allows for the passage of air and facilitates mechanical ventilation, which is essential in various medical settings such as surgeries, emergencies, and intensive care units (ICUs).

Significance of tracheal intubation:

Tracheal intubation plays a vital role in proper oxygenation and ventilation in patients who are unable to breathe spontaneously due to various medical conditions or procedures. Some of the reasons for performing tracheal intubation include:

1. Airway Protection: Intubation helps protect the airway from aspiration of fluids or foreign objects, which further prevents the potential complications such as pneumonia or choking.
2. Ventilation Support: In patients with respiratory failure or compromised lung function, mechanical ventilation provided through an endotracheal tube helps deliver oxygen and remove carbon dioxide from the lungs.
3. Facilitation of Anesthesia: Tracheal intubation is often performed as part of anesthesia induction during surgeries to maintain a patent airway and ensure adequate oxygenation and ventilation while the patient is under anesthesia.
4. Management of Trauma and Emergencies: In cases of trauma, cardiac arrest, or respiratory distress, prompt intubation may be necessary to secure the airway and provide life-saving interventions.
5. Diagnostic and Therapeutic Procedures: Intubation may also be required for certain diagnostic procedures (e.g., bronchoscopy) or therapeutic interventions (e.g., suctioning of airway secretions).

Technique of Insertion:

The process of tracheal intubation typically involves:

Airway assessment is done by anaesthetist by Mallampati grading and many other views which includes assessing the patient's airway.

Appropriate equipment and medications are available, and obtaining informed consent if possible.

The extension atlanto- occipital joint and flexion at cervical spine is must and this position is achieved by putting a 6 cm pillow under the patients occiput. Choose the appropriate laryngoscope blade and insert it from the right side of the patient’s mouth and introduce slowly by displacing tongue to left until the epiglottis is seen . During laryngoscopy there may be laryngospasm and hypertension so to blunt these responses sufentanil and intravenous xylocard 2% should be employed .Once the epiglottis is seen, advance anteriorly so as to lift and for the visualisation of glottis, after this visualisation the et tube is passed down between vocal cords and the cuff of et tube is inflated , the cuff should be 2 - 2.5 cm below vocal cords. the position of the ET tube should be checked by auscultation and capnography. It is important to put the cuff pressure less than 30 cm H2O so as to prevent tracheal ischemia. It is important to secure the endotracheal tube in place to prevent accidental dislodgement.

After Tracheal intubation, Immediately after induction of general anaesthesia, additional agents are necessary to maintain the anaesthetic state since most induction agents have a brief duration of action. This topic will discuss use of inhalation and intravenous (IV) agents during the maintenance phase of general anaesthesia.

The maintenance phase of general anaesthesia after tracheal intubation is an important period in the perioperative care of surgical patients. Effective management requires a comprehensive approach encompassing the administration of anaesthetic agents, maintenance of muscle relaxation, provision of analgesia, and optimization of ventilation and oxygenation. Close monitoring, vigilant fluid management, temperature control, and careful emergence planning are essential to ensure patient safety and facilitate a smooth recovery from anaesthesia. Despite the challenges and potential complications, adherence to evidence-based practices and ongoing advancements in anaesthesia technology continue to improve outcomes for patients undergoing surgical procedures under general anesthesia.

The minimum Alveolar concentration (MAC) indicates the potency of an anesthetic needed to prevent movement in half of the patients during surgery. It helps compare the strength of different anaesthetic agents. Compounds with high MAC have low potency, like desflurane, while those with low MAC are highly potent, such as halothane.

Factors like pyrexia, thyrotoxicosis, decreased age, chronic drug abuse, and chronic alcohol intake increase MAC, making anaesthesia harder to achieve. Conversely, hypotension, hypothermia, pregnancy, and hypothyroidism decrease MAC, making anaesthesia easier to achieve.

Comparison of Vecuronium and Rocuronium

Vecuronium bromide was first introduced in the late 1970s by scientists at Organon International, and the medical use in the early 1980s .

Vecuronium became a widely used muscle relaxant in the practice of anaesthesia, in about the 1990s . On the other hand, Rocuronium bromide was developed as a derivative of vecuronium by Organon International. It was first introduced in 1990 , it was mainly designed to have a quicker onset of action and shorter duration as compared to vecuronium. Both vecuronium and rocuronium are continuously used in the anaesthetic era and current day practice.

VECURONIUM

Vecuronium is a non-depolarizing neuromuscular blocking agent used in anaesthesia to induce muscle relaxation during surgery or many times at mechanical ventilationIt belongs to the aminosteroid class of neuromuscular blockers and acts by competitively binding to the nicotinic acetylcholine receptors at the neuromuscular junction, thereby blocking the action of acetylcholine and preventing muscle contraction.

Its duration of action is typically longer than other neuromuscular blockers like rocuronium, which offers advantages in certain clinical scenarios. It is given intravenously, bypassing absorption concerns associated with oral routes. Therefore, it exhibits rapid and complete systemic availability.It has a high volume of distribution, which indicates the extensive tissue distribution far from the plasma compartment. It is primarily distributed into skeletal muscle and fat tissues. The drug does not readily cross the blood-brain barrier, resulting in minimal central nervous system effects.It undergoes hepatic metabolism primarily through Hofmann elimination, a nonenzymatic process involving degradation at physiological pH and temperature. This metabolic pathway does not rely on liver enzymes, reducing the likelihood of drug interactions mediated by cytochrome P450 enzymes. As a result, vecuronium is less susceptible to variations in hepatic function and drug-drug interactions compared to other neuromuscular blocking agents metabolized by enzymatic pathways.The primary route of elimination for vecuronium is renal excretion of metabolites, with approximately 40-60% of the drug excreted unchanged in the urine. The elimination half-life of vecuronium ranges from 60 to 90 minutes in patients with normal renal function. However, in patients with impaired renal function, elimination may be prolonged, necessitating dose adjustments to avoid accumulation and prolonged neuromuscular blockade.

Factors affecting pharmacokinetics:

Impaired renal function can prolong the elimination half-life of vecuronium, necessitating dosage adjustments to prevent drug accumulation and prolonged neuromuscular blockade.

Vecuronium's metabolism is not dependent on liver enzymes, making it less susceptible to alterations in hepatic function compared to other drugs metabolized by the liver. Advanced age may alter vecuronium pharmacokinetics due to changes in renal function and muscle mass. Elderly patients may exhibit prolonged drug elimination, requiring dosage adjustments to minimize the risk of prolonged neuromuscular blockade.

Vecuronium's distribution is influenced by body weight and composition, with higher doses required in patients with increased lean body mass or obesity to achieve the desired effect.

It competitively blocks acetylcholine receptors at the neuromuscular junction, preventing the action potential from reaching the muscle fibers, resulting in paralysis. Its onset of action is rapid, typically within 1-2 minutes, with effects lasting 20-30 minutes. The duration and depth of paralysis can be titrated by adjusting the dose. Vecuronium lacks significant cardiovascular effects, making it suitable for patients with cardiovascular disease. However, it can cause prolonged paralysis in patients with hepatic or renal dysfunction due to decreased clearance.

Initial doses of 80_ 100 μg/kg are considered sufficient to allow intubation. Because of its lack of cardiovascular side effects, it can be given in larger doses that may primarily shorten the time of onset and prolong the duration but the rate of recovery from 75% to 25% block is significantly faster with vecuronium.

Repeated doses are given when TOF ratio returns to 0.2 _ 0.25 percent and will0 extend the block by 15 - 20 minutes .It typically has an onset of action within 1 to 3 minutes after administration, with maximal effect occurring within 3 to 5 minutes. The duration of action is dose-dependent but generally lasts around 30 to 60 minutes. During intubation and throughout the procedure, continuously monitor the patient's neuromuscular function using methods such as train-of-four (TOF) stimulation or peripheral nerve stimulators. It is most cardiovascular stable , and is muscle relaxant of choice for cardiac patients.

Dose for rapid sequence intubation:

0.1 mg/kg to 0.2 mg/kg IV, with the onset of intubation conditions occurring in less than 2 to 3 minutes

Maintenance for continued surgical relaxation:

0.01 mg/kg to 0.015 mg/kg IV to be given 20 to 45 minutes after the initial dose and every 12 to 15 minutes as needed.

Adverse effects:

Respiratory depression is often due to vecuronium because it can cause paralysis of respiratory muscles, which leads to hypoventilation or respiratory arrest if not treated.

Vecuronium can cause a decrease in blood pressure, particularly in patients who are hypovolemic or sensitive to the effects of neuromuscular blocking agents.

Sometimes vecuronium leads to bradycardia when used combinedly with heart medications.

In patients with hepatic and renal impairment the effects of vecuronium can prolong the neuromuscular function.

Rare anaphylaxis have been reported with vecuronium.

Contraindications:

Patients with known hypersensitivity or allergy to vecuronium or any of its components should not receive the vecuronium.

Vecuronium may exacerbate muscle weakness in patients with myasthenia gravis.

Caution should be exercised in patients with impaired renal or hepatic function, as vecuronium's metabolism and elimination may be altered.

Patients with significant electrolyte imbalances, such as hypokalemia or hyperkalemia, may experience altered responses to vecuronium.

Patients with certain neuromuscular diseases, such as Eaton-Lambert syndrome, may have increased sensitivity to vecuronium.

Vecuronium should be used with caution in pregnant or lactating women, weighing the potential risks against benefits and considering alternative treatments if possible.

Complications:

- Hypotension
- Histamine release.
- Prolong paralysis.
- Residual paralysis.
- Allergic reactions (rare).
- Bronchospasm, patients with a history of asthma.
- Hyperkalemia, in patients with extensive muscle trauma , having increased serum potassium level.
- Bradycardia , when used with Opioids.

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