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Review on Local and General Anesthesia

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Abstract: *Objective. To assess hearing results following primary stapes surgery in patients with otosclerosis, comparing local and general anesthesia. Data Sources. PubMed, Embase, the Cochrane Library, CINAHL, and Scopus. Review Methods. A systematic search was conducted, followed by assessment of directness of evidence and risk of bias. Studies reporting original data on the effect of local anesthesia, compared to general anesthesia, on closure of air-bone gap in patients undergoing stapes surgery for otosclerosis were included. Results. A total of 257 unique studies were retrieved, of which 3 (including 417 procedures) satisfied the eligibility criteria. Assessment showed that all studies carried high risk of bias, and only 1 study provided direct evidence. Conclusion. There is no difference in postoperative air-bone gap, worsening of sensorineural hearing loss, and postoperative vertigo between the 2 groups. A statistically significant increased risk of immediate dead ear following stapes surgery performed under general anesthesia was reported in 1 study.*

Keywords: Anesthesia

I. INTRODUCTION

Recovery from anesthesia: The return of the patient to consciousness. The reverse of induction; that is, redistribution from the site of action (rather than metabolism of the anesthetic). D. Depth of anesthesia: Guedel (1920) described 4 stages with Ether anesthetic agent, include: 1. Stage I (Analgesia): pt still conscious with amnesia, reduced awareness of pain & touching, increased hearing sense, & normal respiration. - The degree of analgesia actually varies greatly with different agents. It is pronounced with Ether and Nitrous oxide but not with Halothane. Anesthesia, a cornerstone in medical practice, plays a pivotal role in ensuring patient comfort and safety during medical procedures. This thesis delves into the nuanced realms of local and general anesthesia, exploring their historical evolution, mechanisms of action, types, and applications. By examining the advantages, disadvantages, safety considerations, and patient experiences associated with each modality, this research aims to provide a comprehensive understanding of the current landscape of anesthesia. Furthermore, the exploration of emerging technologies, ethical considerations, and future directions seeks to illuminate the evolving nature of anesthesia practices, laying the foundation for informed decision-making and continued advancements in patient careAnesthesia, a critical facet of modern medical interventions, stands as the vanguard in alleviating pain and ensuring patient safety during a spectrum of procedures. This thesis embarks on a comprehensive exploration of two primary modalities: local and general anesthesia. These modalities, with their distinct mechanisms and applications, form the backbone of anesthesia practice, shaping the landscape of contemporary healthcare.[1]

Anesthesia, a cornerstone in modern medical practice, stands as the vanguard in alleviating pain and ensuring patient safety during a spectrum of procedures. This thesis embarks on a comprehensive exploration of two primary modalities: local and general anesthesia. These modalities, with their distinct mechanisms and applications, form the backbone of anesthesia practice, shaping the landscape of contemporary healthcare.

The historical underpinnings of anesthesia provide a fascinating journey through time, from the serendipitous discovery of ether to the sophisticated techniques employed in the present day. This evolution marks significant breakthroughs, each contributing to the refinement of anesthesia, making it an indispensable tool in medical practice.

Anesthetic Drug:-

Anesthesia - Means lack of feeling, a state in which there is loss of sensation produced by anesthetic agents. It is of 2 types, general anesthesia (GA) & local anesthesia (LA). - There is no ideal anesthetic agent, therefore a combination of drugs were used. The properties of ideal anesthetic agent include (rapid induction & rapid recovery, wide margin of

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safety, analgesia & skeletal muscle relaxation, not irritant, not inflammable, not explosive, not ↑capillary bleeding, no unpleasant taste or smell, no nausea or hangover.

General aspects of anesthesia:-

The practice of anesthetist has three main parts:

1. Before surgery (pre-medication): the principle is to provide:

a. Sedation and amnesia (by using diazepam to reduce anxiety & stress): pt who is going to do operation is normally afraid, thus needs some explanation about his operation that it is simple, it needs not long time to do the operation and so on

b. Analgesia (by using pethidine or morphine): very important when there is an existing pain, or to produce analgesia as a supplement to a weak anesthetic agent. Analgesia is not required if there is no existing pain. However if post-operation is expected an analgesic drug may be given at the end of the operation without waiting for the pt to complain of pain.

c. Inhibition of para-sympathetic autonomic system (by using antimuscarinic agent, atropine or hyoscine to reduce bronchial secretion, salivary glands secretion, reflex bradycardia & hypotension. - Typical combination of drugs used in premedication includes morphine & hyoscine or pethidine & atropine, usually given 1hr before operation.

2. During surgery:-

The most important is to produce sleep, analgesia and muscle relaxation by using a single drug or more than one drug.

3. After surgery:-

The anesthetist ensures that the effects of hypnotic, analgesic and muscle relaxant are adequate. The pt must never be left alone until he is conscious that may be he needs: antibiotic, analgesic, sedative, tranquilizer, purgative, enemas, hypotensive or hypertensive agent, anticoagulant, steroid, diuretic, bronchodilators etc

II. HISTORY AND DEVELOPMENT OF LOCAL ANESTHESIA

The roots of local anesthesia can be traced back to ancient civilizations where various substances, such as opium and alcohol, were utilized for their numbing properties. However, the true advent of local anesthesia emerged in the 19th century.

1. Discovery of Ether and Chloroform: The use of ether and chloroform as general anesthetics by William T.G. Morton and James Young Simpson in the mid-1800s marked a watershed moment in the history of anesthesia. While initially used for general anesthesia, their localized effects on nerve endings paved the way for the development of local anesthesia.

2. Cocaine as a Local Anesthetic: In the late 19th century, the discovery of the local anesthetic properties of cocaine by Carl Koller revolutionized surgical practice. This breakthrough allowed for more precise and localized pain management, particularly in ophthalmic procedures.

3. Introduction of Novocain: The synthesis and introduction of Novocain (procaine) by Alfred Einhorn in the early 20th century further advanced local anesthesia. Novocain became a widely used and safer alternative to cocaine, reducing the risk of systemic toxicity.[3]

III. HISTORY AND DEVELOPMENT OF GENERAL ANESTHESIA

The development of general anesthesia is marked by pioneering efforts to induce a state of unconsciousness, allowing for pain-free surgeries and medical procedures.

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1. Ether Day: On October 16, 1846, William T.G. Morton administered ether to a patient during surgery at the Massachusetts General Hospital, an event known as "Ether Day." This marked the first successful public demonstration of general anesthesia, forever changing the landscape of surgery.

2. Chloroform and Ether in Surgery: The introduction of chloroform and ether into surgical practice led to increased acceptance and utilization of general anesthesia. These agents allowed for more controlled and predictable induction and maintenance of unconsciousness during surgeries.

3. Advancements in Inhalation Anesthetics: The 20th century witnessed significant advancements in inhalation anesthetics, with the introduction of halothane, enflurane, and other volatile agents. These substances provided more precise control over anesthesia depth and improved patient safety.

4. Intravenous Anesthetics: The development of intravenous anesthetics, such as thiopental and propofol, represented another milestone in general anesthesia. These agents offered rapid induction and recovery, contributing to the efficiency of surgical procedures.

These breakthroughs collectively transformed the landscape of anesthesia, enabling medical professionals to perform increasingly complex surgeries with improved patient outcomes. The history and development of both local and general anesthesia reflect a continual commitment to refining techniques and ensuring the safety and well-being of patients undergoing medical interventions.[4]

Types of Anesthesia:

Anesthesia is a critical component of medical practice, ensuring patient comfort and safety during surgical and medical procedures. Two primary types of anesthesia, local and general, serve distinct purposes, each tailored to specific medical scenarios.

1. Local Anesthesia:

Detailing the Differences:

Local anesthesia involves the administration of anesthetic agents to a specific part of the body, resulting in the temporary loss of sensation in that localized area. Unlike general anesthesia, the patient remains conscious and aware during the procedure. Local anesthetics work by blocking nerve signals in the targeted region, preventing the transmission of pain sensations.[9]

Applications in Various Medical Procedures:

Local anesthesia finds applications in a wide range of medical procedures, particularly those of minor to moderate invasiveness. Some common scenarios include:

- Dental Procedures: Local anesthesia is extensively used in dentistry for procedures such as tooth extractions, root canals, and gum surgeries.

-Dermatological Interventions: Skin biopsies, mole removals, and other dermatological procedures often utilize local anesthesia.

- Joint Injections: Injections for pain management or therapeutic purposes in joints are commonly performed under local anesthesia.

- Eye Surgeries: Certain eye surgeries, such as cataract surgery, may involve the use of local anesthesia.

Local anesthesia provides targeted pain relief while minimizing the systemic effects associated patient's consciousness and cooperation is beneficial

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2. General Anesthesia:

Detailing the Differences:

General anesthesia induces a reversible state of unconsciousness, rendering the patient completely unaware and unresponsive to external stimuli. Unlike local anesthesia, which targets a specific area, general anesthesia affects the entire body. It involves the administration of inhaled gases or intravenous medications to achieve and maintain a controlled state of unconsciousness.[11]

Applications in Various Medical Procedures:

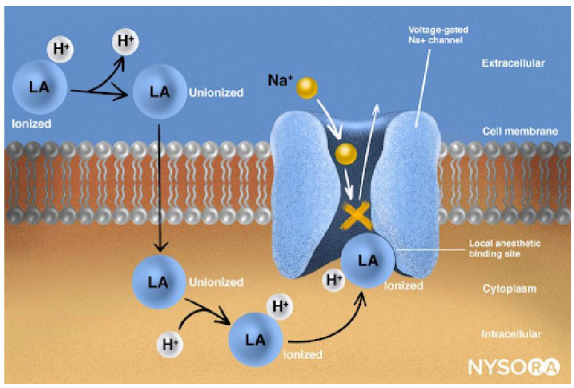
General anesthesia is employed in a broader range of medical procedures, especially those that are more complex, invasive, or intolerable for the patient to undergo while conscious. Common applications include:

- **Major Surgeries:** General anesthesia is commonly used for procedures such as abdominal surgeries, cardiovascular surgeries, and neurosurgical interventions.
- **Obstetric Procedures:** Cesarean sections and certain high-risk deliveries may involve the use of general anesthesia.
- **Endoscopic Procedures:** Some endoscopic examinations and interventions, particularly those requiring patient immobility, are performed under general anesthesia.
- **Diagnostic Imaging:** Certain diagnostic imaging procedures, such as magnetic resonance imaging (MRI), may require general anesthesia for patient comfort and cooperation.[12]

Mechanism of Action:

Understanding the mechanism of action of local and general anesthesia requires delving into the intricate ways in which these agents interact with the nervous system to achieve their respective effects.

1. Local Anesthesia:



Physiological Mechanism:

Local anesthetics primarily act by blocking nerve conduction in the region where they are applied. These agents, commonly of the amide or ester class, work by inhibiting the function of voltage-gated sodium channels present in nerve cell membranes. The key steps in the mechanism of local anesthesia include:

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- Blocking Sodium Channels: Local anesthetics, in their ionized form, penetrate nerve cell membranes and bind to specific sites on sodium channels. This binding inhibits the influx of sodium ions, preventing the generation and propagation of action potentials along the nerve fibers.

- Preventing Nerve Impulses: By blocking sodium channels, local anesthetics interrupt the normal flow of electrical signals along the nerve fibers. This leads to the temporary loss of sensation and motor function in the localized area where the anesthetic is applied.

- Reversibility: Local anesthesia is reversible because the binding of the anesthetic agent to sodium channels is not permanent. As the drug is metabolized or diffuses away from the nerve endings, the channels gradually regain their normal function, restoring sensation and motor control.

Duration and Factors Influencing Effectiveness:

The duration of local anesthesia depends on factors such as the specific anesthetic agent used, the vascularity of the tissue, and the presence of vasoconstrictors in the anesthetic solution. Vasoconstrictors, like epinephrine, can be added to local anesthetics to prolong their effect by reducing blood flow and slowing systemic absorption.[13]

Local Anesthesia:

Advantages:

1. Targeted Pain Relief: Local anesthesia provides precise pain relief to a specific area, allowing for focused interventions without affecting the entire body.

2. Conscious Patient Participation: Patients under local anesthesia remain conscious, enabling communication with the healthcare team and, in some cases, active participation in procedures.

3. Reduced Systemic Effects: Local anesthesia minimizes the risk of systemic side effects and complications associated with general anesthesia, making it a safer option for certain individuals.

4. Shorter Recovery Time: Since the patient remains conscious, recovery time is typically shorter compared to general anesthesia, allowing for quicker ambulation and discharge.

Disadvantages:

1. Limited Application: Local anesthesia is suitable for minor to moderate procedures but may not be sufficient for more extensive surgeries or interventions.

2. Psychological Impact: Some patients may experience anxiety or discomfort witnessing the procedure despite being pain-free, potentially leading to psychological distress.

3. Technical Challenges: Achieving and maintaining adequate anesthesia in certain anatomical regions may pose challenges, requiring skill and expertise on the part of the healthcare provider.[15]

General Anesthesia:

Advantages:

1. Complete Unconsciousness: General anesthesia induces a state of complete unconsciousness, ensuring that patients are unaware and unresponsive to stimuli during the procedure.
2. Suitability for Complex Procedures: It is well-suited for complex surgeries and medical interventions where a lack of patient movement and consciousness is essential for the safety and success of the procedure.
3. Control over Physiological Functions: General anesthesia provides control over vital physiological functions, such as breathing and heart rate, optimizing conditions for surgery.
4. Management of Pain and Anxiety: General anesthesia effectively manages pain and anxiety, offering a more comfortable experience for patients undergoing invasive procedures.

Disadvantages:

1. Systemic Effects: General anesthesia affects the entire body, leading to potential systemic complications, including respiratory and cardiovascular effects.

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2. Postoperative Recovery Time: Recovery from general anesthesia may take longer, and patients may experience postoperative side effects such as nausea and confusion.

3. Risk of Anesthetic Complications: General anesthesia carries a higher risk of complications, including rare but serious events like malignant hyperthermia or allergic reactions.[16]

Impact on the Field:

Automation of Tasks: Robotic anesthesia systems can automate routine tasks, allowing anesthesia providers to focus on more complex aspects of patient care.

Consistency and Standardization: By reducing the variability in drug administration, robotic systems may contribute to greater consistency in anesthesia delivery.

Bispectral Index (BIS) Monitoring:

Advancements: BIS monitoring involves the use of electroencephalography (EEG) to measure the depth of anesthesia. It provides a numerical value indicating the patient's level of consciousness.

Impact on the Field:

Objective Measurement: BIS monitoring offers an objective measure of the depth of anesthesia, helping anesthesia providers titrate medications more precisely.

Avoidance of Over-Sedation: This technology may help prevent over-sedation, reducing the risk of postoperative complications and promoting a smoother recovery.[23]

IV. CONCLUSION

The exploration of local and general anesthesia is a comprehensive journey through the intricacies of medical interventions aimed at alleviating pain and ensuring patient safety. This thesis has delved into the historical evolution, mechanisms of action, types, advantages, and disadvantages of both anesthesia modalities. It has also touched upon the vital aspects of patient experience, safety considerations, and ethical dilemmas faced by healthcare providers in administering anesthesia The available studies on the effect of local anesthesia, compared to general anesthesia, on postoperative air-bone gap in patients undergoing stapes surgery carry substantial high risk of bias. This precludes firm conclusions. All of the studies show no difference in postoperative air-bone gap, sensorineural hearing loss, and postoperative vertigo between the 2 groups. One study, with high directness of evidence and high risk of bias, reported an increased risk of immediate dead ear following stapes surgery under general anesthesia. Taking into consideration the risk of immediate dead ear and the patient's wishes, it was decided to perform stapes surgery under local anesthesia in this patient.

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