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Special Considerations in Pediatrics for Rapid Intubation Sequence

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ABSTRACT

The rapid intubation sequence (RISS) in children is a fundamental procedure used in emergency situations and pediatric critical care to ensure a safe airway and establish effective mechanical ventilation. This study aims to provide a comprehensive and up-to-date review of SIR in children, focusing on key aspects related to its clinical application.

The essential steps of SIR in children are reviewed in detail, including pre-preparation, administration of sedative and muscle relaxant agents, induction of anesthesia, laryngoscopy, insertion of the endotracheal tube, confirmation of proper tube position, and subsequent respiratory support. Anatomic and physiologic differences between children and adults are highlighted, and specific considerations to be taken into account when performing SIR in this vulnerable population are described.

In addition, the different drugs used for sedation and muscle relaxation in pediatric RDS are discussed in depth, highlighting dosages, pharmacologic effects, and potential associated complications. The importance of careful selection of appropriate agents and doses based on the child's age, weight, and clinical condition is discussed.

It also addresses the use of specific medical equipment in pediatric RDS, such as pediatric laryngoscopes, adapted endotracheal tubes, pediatric videolaryngoscopy devices and capnographs, highlighting their relevance in the accurate visualization of the airway and confirmation of adequate intubation.

Finally, the importance of adequate training, clinical expertise and multidisciplinary collaboration in the successful performance of SIR in children is highlighted. Emphasis is placed on the need for continuous monitoring and meticulous evaluation throughout the procedure, as well as the implementation of strategies to minimize risks and potential complications.

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INTRODUCTION

The rapid intubation sequence is a specialized medical procedure used in critical situations to ensure an adequate airway and facilitate mechanical ventilation in patients requiring urgent endotracheal intubation.[1]

This approach is carried out through the simultaneous and coordinated administration of certain drugs and specific maneuvers by a trained medical team, with the aim of minimizing the risk of complications and optimizing the safety and efficacy of the procedure.[2]

The rapid intubation sequence begins with the administration of a fast-acting anesthetic agent, such as thiopental or propofol, to rapidly induce loss of consciousness in the patient. This is accompanied by the administration of a non-depolarizing muscle relaxant, such as rocuronium or vecuronium, to facilitate intubation and prevent muscle response that could hinder the procedure.[2]

Once the patient is sedated and paralyzed, laryngoscopy is performed, which involves the insertion of a laryngoscope into the oral cavity to visualize and access the vocal cords. With the aid of this tool, an endotracheal tube is carefully inserted through the glottis and properly secured in the trachea, allowing air to pass into the lungs.[3]

In addition to the intubation itself, other adjunctive measures are performed during the rapid intubation sequence. This may include administration of supplemental oxygen, external manipulation of the larynx (cricoid manipulation), placement of a bougie cannula to guide the endotracheal tube, or the use of advanced visualization devices such as a videolaryngoscope.[3]

It is important to note that the rapid intubation sequence requires a high degree of knowledge and skill on the part of the medical team, as the procedure carries certain risks and must be performed with precision to avoid serious complications, such as hypoxemia, airway trauma or bronchoaspiration.[4]

Steps to consider:

The rapid intubation sequence is composed of several meticulous and well-coordinated steps, involving the administration of medications and the performance of specific maneuvers. Each of these steps is described in detail below:

Preparation and assessment: Before starting the rapid intubation sequence, a thorough assessment of the patient is performed and proper preparation of the necessary equipment is carried out. This involves checking the functioning of the laryngoscope, ensuring that the required medications are available, as well as having the appropriate size and type of endotracheal tubes and probes.[4]

Preoxygenation: Supplemental oxygen administration is initiated by means of a tight-fitting face mask or reservoir bag ventilation. The goal of preoxygenation is to increase oxygen saturation in the lungs and oxygen stores prior to induction of sedation and muscle paralysis.[5]

Induction of sedation: A fast-acting anesthetic agent, such as thiopental or propofol, is administered to rapidly induce loss of consciousness in the patient. These drugs act on the central nervous system and produce a state of deep sedation, which facilitates the intubation procedure.[5]

Muscle paralysis: Simultaneously with the induction of sedation, a non-depolarizing muscle relaxant such as rocuronium or vecuronium is administered. These drugs block neuromuscular transmission and produce a temporary and reversible paralysis of skeletal muscles, including respiratory muscles. Muscle paralysis facilitates insertion of the endotracheal tube and prevents muscle response that could hinder the procedure.[6]

Laryngoscopy and endotracheal tube insertion: Once the patient is adequately sedated and paralyzed, laryngoscopy is performed. This involves the careful insertion of a laryngoscope into the oral cavity to visualize the vocal cords and obtain a clear view of the airway. With the aid of the laryngoscope, the endotracheal tube is inserted through the glottis and advanced into the trachea. Adequate confirmation of proper placement of the endotracheal tube is made by auscultation of the bilateral breath sounds and detection of the presence of carbon dioxide in the airway.[7]

Confirmation and securing of the endotracheal tube: Once the endotracheal tube is in its proper position, further confirmation of its correct placement is performed using complementary methods, such as bilateral auscultation, detection of carbon dioxide in the airway by capnography, observation of symmetrical chest expansion during ventilation and chest X-ray afterwards.[8]

Mechanical ventilation and monitoring: Once the endotracheal tube is secured, controlled mechanical ventilation is initiated, using a ventilator or a manual ventilation bag connected to an oxygen source. Throughout the procedure, vital signs, oxygen saturation, heart rate and blood pressure are continuously monitored, as well as the presence of any complications or adverse events.[8]

The rapid intubation sequence involves a series of steps including patient preparation and assessment, preoxygenation, induction of sedation, muscle paralysis, laryngoscopy and endotracheal tube insertion, tube confirmation and securing, and finally mechanical ventilation and continuous monitoring. These steps are designed to ensure safe and efficient intubation in critical situations and provide an adequate airway for ventilation and oxygenation of the patient.[8]

Considerations and differences in adults and children

Sedative drugs

For adults, there is a tendency to use fast-acting anesthetic agents, such as thiopental or propofol, to induce sedation and non-depolarizing muscle relaxants, such as rocuronium or vecuronium, to achieve muscle paralysis. These drugs are usually administered in standard doses based on adult body weight.[9]

On the other hand, in children, the dosage of drugs used in the rapid intubation sequence is based on their weight, age and developmental stage. In addition, preferences in the choice of anesthetic agents may vary according to the age and individual response of the child. In general, shorter and faster-acting agents, such as sevoflurane or desflurane, are usually preferred to induce sedation in children. In the rapid intubation sequence in children, the drug used for sedation varies according to the age and individual characteristics of the child. Among the most commonly used anesthetic agents are inhaled anesthetics, such as sevoflurane and desflurane, as well as rapid-acting intravenous agents, such as propofol and etomidate.[9]

Sevoflurane is an inhaled anesthetic that is widely used in children due to its rapid induction and recovery, as well as its safety profile. It is administered through a face mask or nasal cannula and the concentration is adjusted according to the patient's needs. Sevoflurane provides deep sedation and allows rapid airway control during the intubation procedure.[10]

Another inhaled anesthetic used for sedation in children is desflurane. Like sevoflurane, it is administered through a face mask or nasal cannula. However, desflurane may have a more unpleasant taste and may cause upper airway irritation, limiting its use in some cases.[10]

In situations where the intravenous route is preferred, propofol is a fast-acting anesthetic agent that is frequently used in the rapid intubation sequence in children. It is administered intravenously and produces rapid and deep sedation. Propofol has hypnotic and amnesic properties, which helps induce loss of consciousness and facilitates endotracheal intubation.[11]

Another intravenous drug used for sedation in children is etomidate. This anesthetic agent produces deep sedation and has hypnotic properties. It is particularly useful in patients with cardiovascular disease or hypovolemia, as it has minimal effect on blood pressure and cardiac output.[11]

The choice of drug for sedation in the rapid intubation sequence in children will depend on several factors, including age, weight, underlying medical condition, and anesthesiologist preference. It is important to have the knowledge and experience to administer these drugs safely and to adjust doses according to the individual needs of the child.[11]

Choice of muscle relaxant

As for muscle relaxants, they are also used in children, but their choice and dosage vary according to the age and weight of the child. In some cases, depolarizing muscle relaxants, such as succinylcholine, may be used in older children, but caution should be exercised because of possible side effects, such as malignant hyperthermia.[12]

In the rapid intubation sequence in children, muscle relaxants are used to achieve the necessary muscle paralysis and facilitate endotracheal intubation. Among the most commonly used muscle relaxants are non-depolarizing neuromuscular blocking agents such as rocuronium, vecuronium and atracurium.[12]

Rocuronium is a fast-acting non-depolarizing neuromuscular blocker that is widely used in the intubation of children. It acts by competing with acetylcholine at neuromuscular plate receptors, thereby blocking neuromuscular transmission and producing muscle relaxation. Rocuronium has a rapid onset of action and an intermediate duration, allowing adequate muscle relaxation during the intubation procedure. [12]

Vecuronium is another non-depolarizing neuromuscular blocker used in the rapid intubation sequence in children. Like rocuronium, it acts by inhibiting neuromuscular transmission. However, vecuronium has a longer duration of action compared to rocuronium. This may be advantageous in situations where sustained muscle paralysis is required during the procedure or during prolonged mechanical ventilation. [12]

Atracurium is another non-depolarizing neuromuscular blocker used in the intubation of children. Unlike rocuronium and vecuronium, atracurium is spontaneously metabolized in the body, which means that its effect is not dependent on hepatic or renal function. This may be beneficial in pediatric patients with hepatic or renal dysfunction, as it allows for more precise control of muscle paralysis. [13]

It is important to note that the dosage and selection of muscle relaxant should be individualized for each child, taking into account weight, age and clinical status. In addition, the patient's response should be closely monitored and the dose adjusted as needed. The potential side effects of muscle relaxants, such as hypotension, tachycardia, and allergic reactions, should also be considered. [12]

In the rapid intubation sequence in children, non-depolarizing neuromuscular blocking agents such as rocuronium, vecuronium and atracurium are used to achieve adequate muscle relaxation and facilitate endotracheal intubation. The choice of muscle relaxant will depend on the individual characteristics of the child and factors such as speed of action, duration of action and possible side effects should be taken into account. [14]

Material of choice

Another significant difference is the choice and size of the equipment used during intubation. In adults, standard size laryngoscopes and endotracheal tubes are used, whereas in children, smaller sizes adapted to their anatomy should be selected. In addition, in young children, the use of special devices, such as pediatric videolaryngoscopes or flexible bronchoscopes, may be required to facilitate visualization and insertion of the endotracheal tube. [15]

In the rapid intubation sequence in children, the use of various specific medical equipment is required to ensure safe and effective intubation. Some of the most commonly used equipment is described below:

Pediatric laryngoscope: The laryngoscope is an essential tool in the intubation procedure. For children, specially designed laryngoscopes are used to accommodate pediatric airway anatomy. These laryngoscopes usually have smaller, curved blades, which facilitate visualization of the vocal cords and insertion of the endotracheal tube. [15]

Pediatric endotracheal tubes: Endotracheal tubes are devices used to secure the airway and allow mechanical ventilation in children. These tubes are available in different sizes and types, and are selected according to the age and size of the child. Pediatric endotracheal tubes are usually smaller and more flexible to fit a child's airway. [16]

Pediatric videolaryngoscopy devices: In some cases, especially when intubation is challenging or enhanced visualization is required, pediatric videolaryngoscopy devices may be used. These devices allow direct visualization of the vocal cords through a camera at the end of the laryngoscope, which facilitates insertion of the endotracheal tube into the pediatric airway. [16]

Capnograph: The capnograph is a device used to measure the concentration of carbon dioxide in the air exhaled by the patient during ventilation. During the rapid intubation sequence in children, the capnograph is used to confirm proper placement of the endotracheal tube in the trachea, as the detection of carbon dioxide is a reliable indicator of a patent airway. [17]

Ventilation equipment: During the intubation procedure and thereafter, adequate ventilation equipment is required to provide respiratory support to the patient. These may include pediatric ventilators or manual ventilation bags connected to an oxygen source. Appropriate sizes and settings should be considered to suit the specific respiratory needs of the child. [18]

Fixation material: Once the endotracheal tube is in place, fixation material is used to secure it in place. This may include pediatric adhesive tapes, clamping devices or child-specific endotracheal tube clamps. It is important to ensure secure and comfortable fixation to prevent accidental dislodgement of the tube. [19]

It is important to note that the rapid intubation sequence in children requires an even more careful approach and special considerations due to their lower physiological reserve and greater susceptibility to hypoxemia. In addition, it should be kept in mind that the selection of drugs and technique used in the rapid intubation sequence in children should be based on experience and specific guidelines for each age group.[20]

CONCLUSIONS

In conclusion, the rapid intubation sequence (RISS) in children is a fundamental procedure in critical pediatric medical care, designed to ensure a safe airway and establish adequate mechanical ventilation in emergency situations. Successful performance of SIR in children requires a thorough understanding of the specific anatomic and physiologic differences in this vulnerable population, as well as expert knowledge of the essential steps and appropriate use of relevant drugs and medical equipment.

It is crucial to recognize that SIR in children presents unique challenges, such as smaller and narrower airways, increased susceptibility to hypoxemia, and a greater likelihood of complications. Therefore, careful selection and dosing of drugs used for sedation and muscle relaxation, as well as the use of medical equipment tailored to pediatric anatomy is required to achieve safe and efficient intubation.

Adequate training and experience are critical to the success of SIR in children. Healthcare professionals must receive rigorous training in the necessary techniques and skills, as well as stay current on advances in pediatric critical care. In addition, multidisciplinary collaboration between medical teams, including anesthesiologists, pediatricians, nurses and technicians, is essential to effectively coordinate the procedure and optimize outcomes.

Ultimately, the main priority of SIR in children is to ensure a patent airway and adequate ventilation, minimizing associated risks and complications. Continuous monitoring and meticulous assessment throughout the procedure are critical to quickly detect and address any problems or changes in the child's condition. With a child-centered approach, individualized care and evidence-based practice, SIR in children can be performed safely and effectively, improving clinical outcomes and saving lives in critical situations.

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