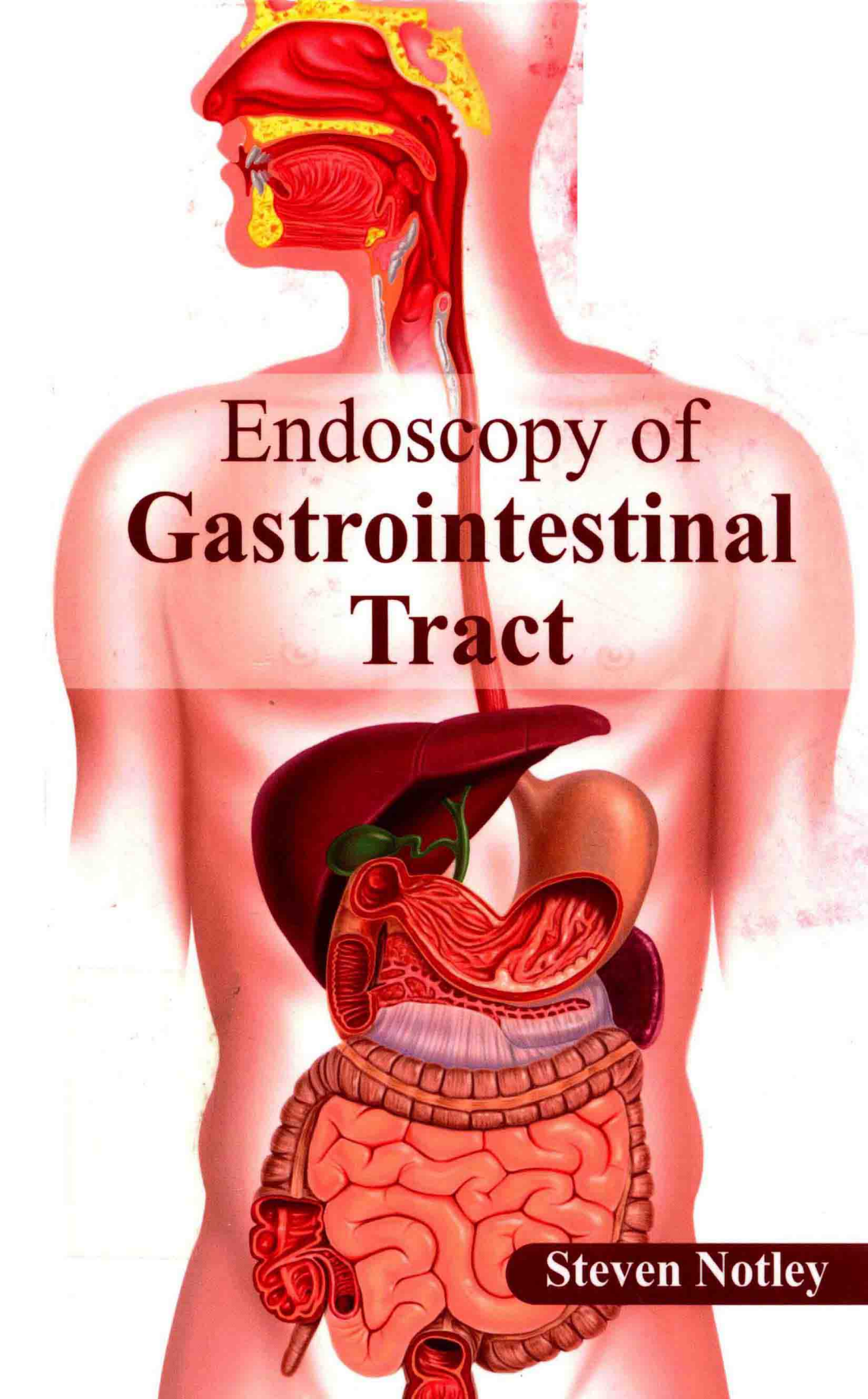


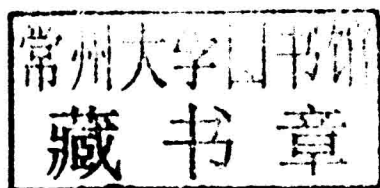
An anatomical illustration of the human gastrointestinal tract, showing the esophagus, stomach, liver, gallbladder, pancreas, and large and small intestines. The illustration is in a reddish-pink color scheme, with the organs shown in cross-section to reveal internal structures. The title 'Endoscopy of Gastrointestinal Tract' is overlaid on the image in a dark red, serif font.

Endoscopy of Gastrointestinal Tract

Steven Notley

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Preface

Endoscopy has played a key role in the advancement of gastroenterology and other medical disciplines. The area of endoscopic procedure has advanced in the past few years. Endoscopic procedure provides an improved comprehension of pathogenic mechanisms, a description of new entities, and is utilized for early detection, diagnostic processes, and therapeutic procedures. Endoscopy has exceeded its role as an examination technique, and has become an efficient therapeutic tool which is not highly invasive.

The researches compiled throughout the book are authentic and of high quality, combining several disciplines and from very diverse regions from around the world. Drawing on the contributions of many researchers from diverse countries, the book's objective is to provide the readers with the latest achievements in the area of research. This book will surely be a source of knowledge to all interested and researching the field.

In the end, I would like to express my deep sense of gratitude to all the authors for meeting the set deadlines in completing and submitting their research chapters. I would also like to thank the publisher for the support offered to us throughout the course of the book. Finally, I extend my sincere thanks to my family for being a constant source of inspiration and encouragement.

Editor

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List of Contributors

General Aspects

Pediatric Sedation Related to Endoscopy

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Urszula Grzybowska–Chlebowczyk, Halina Woś and
Anna Agata Stołtny

Additional information is available at the end of the chapter

1. Introduction

Nowadays, the endoscopy is the basic diagnostic and therapeutic examination in cases of the gastrointestinal diseases, growth and weight gain disorders, gastrointestinal infections and diagnosis and treatment of polyps, the bile duct stones, etc. The endoscopy is a minimally invasive procedure but it is not free from the unpleasant sensations and sometimes severe pain. The endoscopic procedure can be performed as hospitalization or outpatient examination. Staying in hospital and endoscopy can be a very unpleasant experience and a strong stress, that may cause the withdrawal of a child in the development up to the so-called "several stages of development". Children under 18 years old should be anesthetized and operated by trained personnel, in specialized pediatric centers possessing a recovery room, post-operative intensive care and intensive care unit. Children who do not cooperate due to age, stage of development, certain diseases of the CNS, lack of understanding of the situation, fear of the unknown, separation from parents or guardians, previous bad experiences, rebellion and negativism, etc. often than adults require general anesthesia for gastrointestinal endoscopic examinations and the installation of PEG. The presence of parents during the staying in the hospital, preparing for the endoscopic surgery and during the induction of anesthesia and immediately after regaining consciousness helps to alleviate stress and its associated complications. The child is accompanied by both parents and favorite items or toys such as "teddy bear Bordus". Qualifying children for anesthesia is based on medical interview with the parents and child, child's physical examination and full observation. To achieve the best results, avoid critical situations and complications children should be adequately prepared for anesthesia and endoscopy.

2. Preparation of children for anesthesia — Anesthetist visit

Before to a planned endoscopic examination and anesthesia, physical examination should be performed and detailed medical history from patient's parents or legal guardians should be obtained. In addition, the current documentation and results of laboratory tests should be analyzed. Physical examination is aimed at an accurate assessment of the work of the lungs, heart, presence of the heart rate and accurate looking into and assessment of the throat, nasal patency, breathing circuit and possible prediction of difficult intubation. The anesthetic examination of the child before anesthesia is always done in the presence of the parent, guardian or "other party" for example, anesthetic nurses or nurses from the gastroenterology unit. Such situation creates the so-called "triangle" where the anesthesiologist must meet the requirements of both the child and the parent or guardian. This allows to mutual awareness, good contact, to reduce stress to a minimum, gives the opportunity to parents to ask questions and obtain all necessary information needed to make an informed and voluntary decision to consent to anesthesia for endoscopy.

If necessary, the specialist consultation may be ordered for a more specific evaluation of patient's condition and the degree of anesthetic risk according to ASA scale. The decisive influence to the risk of anesthetic have the procedure, the presence of congenital malformations, underlying conditions, concomitant diseases, the history of diseases, infections and their consequences, the perinatal asphyxia, etc. Anesthesia and endoscopy are procedures not required the performance of unnecessary laboratory tests, which should be reduced to a minimum, unless the child's serious condition, results of the consultations, the physical examination, the interview determine the need to perform specific analysis that allows for the safe conduct of the planned procedures. During the preparatory stage because of the period of interruption of oral feeding for several hours and / or cleansing of the colon it is important to put on attention to adequate hydration, glucose levels or levels of electrolytes.

A decision about anesthesia is made by an anesthesiologist on the basis of examination and evaluation of the anesthetic risk in the relation to the mode in which the endoscopic procedure is performed. The course of an anesthetic visit is noted in the anesthetic examination record. After obtaining sufficient information, parents or legal guardians give their informed consent to anesthetic procedure. During the visit, the pharmacological premedication before anesthesia is ordered.

In children with asthma a chronic therapy should not be terminated on the day of anesthesia and surgery, they should receive all regular medications. Children with diabetes should be operated as first, additionally during the procedure 0.9% NaCl should be given because anesthesia and surgery causes hyperglycemia. In the case of hyperglycemia or prolonged surgery the child may receive continuous infusion of regular insulin with glucose. During the treatment it is required to control the levels of glucose, electrolytes and acid - base balance.

Procedures associated with endoscopy should be so created to reduce to a minimum staying of a child in the hospital. Complications of anesthesia in the form of cough, spasms of the larynx and bronchi or respiratory disorders may occur up to several weeks after

infection. In cases of children after infection, the planned surgery should be postponed for about two weeks. After vaccination, anesthesia should be postponed for a week (occurrence of reactions after vaccination).

3. Informed parental consent for anesthesia

Informed consent of parents or legal guardians is to provide information about the purpose, types, course, possible consequences and complications of anesthesia in endoscopy.

After reviewing the written information, presented above problems connected with anesthesia, awakening and post-operative care, parents or guardians have the right to ask questions to obtain additional information, resolve doubts, understand and gain trust to anesthetic and used methods. When all doubts are dispelled, the parents or guardians express informed consent for anesthesia.

4. Preparation of children for anesthesia — Premedication

It is difficult to predict how a child will react in a situation of forced during disconnection from parents, and anesthesia. Even apparently brave child may panic at some time. Oral administration of benzodiazepines, ketamine (nasal) and in some cases, atropine at 30 to 45 minutes before examination causes sedation, easier introduction of anesthesia and reduces the amount of anesthetic agents but extends waking after anesthesia and requires special care and supervision in the form of monitoring of vital signs. Premedication in children is administered orally, nasally or less frequent rectally. Sedatives can have form of lotions, syrups, tablets, drops. Depending on the age and ability to cooperate, to achieve the desired result, the appropriate form of the drug can be applied. Midazolam, according to various authors, is used at doses from 0.2 to 0.6 mg / kg body-weight. To prevent postoperative nausea and vomiting brain serotonin receptors agonist drug is used - ondansetron at a dose of 0.05 to 0.1 mg / kg., generally only in patients with postoperative vomiting in an interview.

Preparation of children and their parents or legal guardians for anesthesia requires from both anesthesiologist and gastroenterologist meeting and discussion in order to explain the nature and necessity of the forthcoming procedures and to resolve any doubts. Premedication is aimed at decreasing the level of patient's anxiety and sedation while waiting for the procedure, on the way to the endoscopy laboratory and directly before and during induction of anesthesia. Premedication in children comprises three elements, two of them are not formal and do not have material form: the constant presence of the parent or guardian near the child, staff's interest and support (showed by an anesthesiologist and gastroenterologist) and appropriate doses of pharmacological agents. Pharmacological agents used for premedication include sedatives and soporifics, antiemetics and antacids. From 120 to 60 minutes before the scheduled surgery, to neutralize and reduce the volume of gastric juice ranitidine or omeprazole is used in doses of: ranitidine from 2 to 4 mg / kg, omeprazole from 0.5 to 3.5 mg / kg.

The advantage of pharmacological premedication is a calm, caring, willingness to cooperate of the child and also decreased need for anesthetics and analgesics necessary during anesthesia. These, outlined above undoubted advantages are reduced by a noticeable disadvantage of premedication which is prolongation of the time to awakening after an anesthesia. Premedication is applied $\frac{1}{2}$ to $\frac{3}{4}$ h before a planned procedure. After premedication, the patient may show various reactions, e.g. agitation, lack of reaction, sedation or excessive sedation including anesthesia.

After the sedative injection may occur agitation and uncontrolled response of the patient (fighter) or anesthesia with all effects that may affect the unconscious patient. During sedation staff must have the monitoring equipment used in resuscitation. This can be illustrated on the six levels Ramsay sedation scale.

1	excited, frightened, impaired consciousness (fighter), inadequate reaction
2	calm, cooperates
3	drowsy, cooperating, responsive to verbal commands
4	deep sedation, does not respond to voice, observed the response to pain
5	anesthesia, sluggish, vestigial reaction to pain
6	deep coma, no reaction to pain

Table 1. Ramsay sedation scale.

Due to the inability to predict the effect of the dose of a substance used as the premedication, which depends on the patient's individual reaction to the administered pharmacological agent, after its administration the patient must be supervised by anesthetic staff, and staff members should be provided with functional equipment for monitoring, intubation and with possibility of application of LMA, maintaining artificial respiration, oxygen therapy and cardiopulmonary resuscitation.

5. Withholding oral fluids and food

Withholding the intake of food and beverages should be considered individually due to the child's age, the eating habits and time of feeding. In the smallest children period of withholding food to the anesthesia should be equal to the gastric emptying time. Its the most common expression is a crying baby demanding food.

Every 2 to 3 hours the newborns' and infants' stomach is empty. Gastric emptying time depends also on the type of food. Gastric emptying after eating takes from 6 to 8 hours, after the liquid such as milk from 4 to 6 hours and after ingestion of a water or tea for about 2 hours. Regularly

every 3 hours breastfed baby empties the stomach in such intervals. It should be noted that the bad general condition of the child, trauma, pain, anxiety can have unpredictably affect to the gastric emptying time. Chewing gum causes salivation and increased secretion in the stomach which increases stomach contents and growth pH.

Before anesthesia and endoscopy patient should be long enough in the fasting state for anesthetic reasons and gastrological indications. For the gastroenterologist empty stomach or intestine are necessary to correctly perform the examination. However, during anesthesia may occur regurgitation of gastric contents or vomiting. Sedation and general anesthesia causes weakness or total abolition of reflexes such as coughing and swallowing which may cause aspiration into the respiratory tract and related severe complications in the form of acute respiratory and / or chemical pneumonia. Withholding food and / or beverages intake depends on the child's age and type of diet. Solid foods should be withheld about 6 to 8 hours before the test, liquid foods about 4 hours, and water or tea can be given about 4 to 2 hours before the anesthesia and endoscopy. In infants fed naturally every signal of hunger and willingness of food intake is a kind of signal "to be fasting." It should also be remembered that withholding food does not guarantee an empty stomach. During the endoscopic examination almost always in the stomach contents can be found some air and colorless or yellow-tinged liquid secretions.

6. Indications for general anesthesia during endoscopic examination in children

Children who cooperate with the medical staff and understand the need for examination, the technique and the course, and who do not show anxiety before and during endoscopy, may be examined after premedication (in sedation). Children who do not cooperate with the staff, insertion of PEG and colonoscopy should be indications for general anesthesia. Anesthesia is intended to protect psyche, reduce fear and its consequences, and relieve pain. The experience of the child and parents, the conviction of the necessity of anesthesia or the total negation of anesthesia during endoscopic should be taken into account.

7. Equipment and special conditions in the endoscopic laboratory for children

The equipment of endoscopy laboratory comprises the general anesthesia apparatus, monitor of anesthesia parameters and vital functions of the patient, high-performance suction device, resuscitation equipment, equipment for difficult intubation, laryngeal masks, and available quick telephone connection with the operating theatre and more experienced colleague or superior. After anesthesia, children should wake up in the recovery room, and if a serious situation or a severe, life-threatening complications occur, intensive therapy (IT) must be available.

8. Vital functions monitoring

During sedation and general anesthesia in children, a continuous presence of anesthetic staff is required as well as adequate monitoring of patient's vital functions, airway patency, chest movements, hemoglobin saturation (SaO_2), ECG, arterial blood pressure, and in some cases in very young children, also body temperature. Staff should also pay attention to the color of skin, respiratory murmur over the lung fields which is a sign of normal alveolar ventilation.

9. Mode of anesthesia and endoscopy

Outpatient surgery refers to patients who have been admitted and examined in one day of staying in hospital. This mode is particularly relevant to children because of the short stay in the hospital and less harmful effect on the psyche. Proceedings under a one day requires proper organization, proper co-operation between all involved i.e. the gastroenterologist, the anesthesiologist, the patient, the family of the patient, family doctor. In this mode, the most important is qualification. First, the parental consent is required, then the patient's condition, appropriate treatment within 24 hours after surgery and anesthesia. In general, to the mode of one day are eligible patients from the risk of anesthesia ASA I and II (exceptionally III if the patient's condition is stable and shortened stay in hospital is beneficial for medical indications - stable diabetes, asthma, patients during chemotherapy). Patients qualified for the one day mode should be older than 6 months. Withholding the intake of food and beverages in children has the same rules as in the mode of hospitalization. Patients who require neutralization of acidic gastric juice should be anesthetized and operated in sufficient time for safe and full action of antacids in the stomach acid content. Shall also be required closer monitoring in the postoperative period.

Criteria for discharge of patients in one day mode: the circulatory and respiratory stability, full wake-up and orientation, the patient can intake food, no pain, no nausea and no vomiting, the patient is able to move themselves, the patient was observed after anesthesia at least 1 hour. Transport to home should be done after the removal of the intravenous cannula, the provision of written and oral information, the order of pain relief treatment, own transport with a 24-hour care and supervision of an informed person. The family must be informed about the possibility of telephone consultations if needed. Driving time to the hospital should not be longer than 1 hour. If one or more of the above criteria are not met, the patient should stay in hospital overnight.

10. Induction and maintaining anesthesia

Induction of anesthesia in children for endoscopy is sometimes a challenge for the pediatric anesthesiologist. If the child has catheter previously introduced into a vein, the induction of anesthesia can be started by giving intravenous anesthetics this way. However, in the absence

of such catheter or in the case when the child's peripheral venous are destroyed by the past infusion due to chronic disease, long, unsuccessful searching of a vein can cause severe stress and mental trauma for both the child and for accompanying persons. The fear of the introduction of the intravenous catheter makes the inhaled induction the method of choice. Parent or guardian is present during induction of anesthesia. Inhalation of the anesthetic gas mixture through a face mask is painless, fast and efficient. Inhalation anesthesia is carried out with semi-closed system with a circular system of pipes for children or adults, and a built-in absorber of carbon dioxide. During inhalation anesthesia spontaneously breathing may be complicated by hypoventilation caused by respiratory depression due to high concentration of anesthetic, laryngospasm and bronchospasm which is caused by respiratory hypersensitivity to irritant effects of inhaled anesthetics and airway disorders of pharynx caused by a reduction in pharyngeal and tongue muscles tone. During inhaled induction of anesthesia should be done close monitoring of the movements of the chest, breath sounds, respiratory additional phenomena in the form of wheezing, rales or rhonchi, skin color, saturation of hemoglobin, heart rate. For inhalational induction in children only sevoflurane is suitable because of the least irritating effect on the respiratory mucosa. The safest method of introduction of anesthesia using sevoflurane is administered to breathe increasing concentrations of the anesthetic with the precise monitoring of the concentration of this gas in the breathing mixture.

Intravenous anesthesia can be performed in children after obtaining venous access. However, this treatment causes a strong stress not only for medical reasons. Often, parents who at that moment when they are unable to cope with the resistance of the child irresponsible scare the child: "if you don't eat dinner you will be injected and get a drip".

Intravenous access is accompanied by sharp, severe pain. Application of proper cream to the puncture site may be helpful and it is good to introduce a catheter into a vein in this place. It is known that for various reasons: age, obesity, previous long-term therapy, oncology treatment, etc. cause significant difficulties in obtaining intravenous access. In addition, it should be noted that the cream can stop the pain, but the stress of a view of the needle will not stop. In such a case, when the child and the parents show excessive anxiety sedative medications must be given. However, sedation raises another problem specific to effects of this drug - there is currently no method to predict the potential effects of the administered drug. Best represents it the Ramsay Sedation Scale (see above). If a child comes to anesthesia with access to the vein, it is very important to carefully check and make sure that the catheter is located in the vein. Paravenous administration of the drug does not give the intended result, may result in overdose or can cause pain, burning, necrosis with defects of adjacent tissue and other complications. In the intravenous induction in children most often is used thiopental at a dose of 4 to 8 mg / kg, but must be remembered that the concentration of this drug in the solution can not exceed 2%. Higher concentrations in the paravenous injection can cause damage to the surrounding tissues and necrosis followed by scarring. Another drug used for intravenous induction is propofol at a dose of 2 to 3.5 mg / kg, which lowers the blood pressure (positively works during intubation and implantation of laryngeal mask what prevent a sudden stroke of blood pressure). During intravenous anesthesia without tracheal intubation in spontane-

ously breathing planned dose should be administered slowly (in fractions) to prevent apnea. Induction of anesthesia should be rapid without unpleasant sensations. Anesthesia should result in the elimination of consciousness and pain, should be as short as possible and should stop immediately after endoscopy, waking should be quick and pleasant. On the one hand the patient should have ensured an adequate level of anesthesia, on the other hand analgesia should not cause respiratory and circulatory depression. Because essentially to this type of examination or procedure the tracheal intubation is not performed, the best care is required to maintain the airway patency and providing the stable alveolar ventilation and the gas exchange. During anesthesia, patients should be placed in the recovery position to provide adequate protection against aspiration in case of regurgitation or vomiting.

It is very important to perform induction very slowly in divided doses due to an individual sensitivity, in order to avoid respiratory disorders and provide adequate level of anesthesia. Analgesics seem to be indispensable due to a low pain threshold during endoscope insertion through the pharynx. A good analgesic agent seems to be fentanyl at a dose of 1 to 2 micrograms/kg b.w., administered in divided doses. The administration of rectal enemas with anesthetics is absolutely contraindicated for colonoscopy and in other cases can not be reliable as to the timing and strength of action - in assuming that the induction of anesthesia and awakening should be quick, pleasant and should not cause stressful situations this method is difficult and unpredictable.

During anesthesia, ECG, hemoglobin saturation and arterial blood pressure should be monitored. Oxygen therapy is important because it prevents desaturation. An equipment for ventilation and tracheal intubation should be kept handy, and in the case of difficult intubation a laryngeal mask and alternative intubation methods should be available (bijou probe, bronchofiberscope, etc.) or immediate contact and help from an experienced colleague should be possible. It is impossible to predict all possible events, but in unclear cases proceedings should be adapted to the situation - preparation of adequate scenarios and discussing them with a gastroenterologist and intensive therapy staff, preparation of necessary equipment or earlier intubation of the patient.

During anesthesia for gastroscopy, colonoscopy, and especially for PEG insertion, a close cooperation between the members of gastroenterological and an aesthetic teams is necessary.

11. Oxygen therapy

During general intravenous anesthesia with preserved patient's own respiration, changes of ventilation and desaturation may occur due to respiratory centre depression. Each time it is necessary to ensure adequate oxygenation, sufficient breathing and maintain a clear airway. In the case of a decrease in ventilation, the respiratory support should be immediately start using an AMBU bag, face mask, tracheal intubation or laryngeal mask (LMA). If airway disorders caused by collapsing of the language occur it is necessary to use the oral airway (Guedel pattern airway). To passive oxygen therapy during upper gastrointestinal endoscopy, a facial mask for oxygen therapy may considerably hinder endoscopic examination. Use of

oxygen masks in children is difficult, especially while waking up, when children poorly tolerate this device. The simplest method of oxygen therapy is insufflation using a thin catheter covered with 2% xylocaine gel, inserted in the nasal passage at depth of 3 to 4 cm; oxygen is administered via this catheter, at flow of 0.5 to 1 liter. The catheter may be fixed with an adhesive tape, and small oxygen flow does not irritate the nasal mucosa or cause needless discomfort. This method can be regarded as an extremely effective and also very economical.

12. Transport of the child after anesthesia

Preparation of the child for transport after anesthesia and endoscopy should be very careful. The level of anesthesia, respiratory efficiency (frequency and depth of breathing), and possibility to maintain airway patency should be evaluated. During transport, oxygen insufflations should be maintained, and ECG and SaO_2 should be monitored. The child should be placed in the recovery position in order to prevent the tongue from blocking patient's airway; in the case of regurgitation or vomiting, it prevents aspiration and related complications. During transport, an anesthesiologist and anesthetic nurse are present, and a resuscitation set is available.

13. Waking up the patient after anesthesia — Observation in the recovery room

During the postoperative period should be pay attention to the efficiency of ventilation, proper hemoglobin saturation, the evacuation of carbon dioxide, effective analgesic (paracetamol, diclofenac, ketonal) and in case of stimulation, confusion, short-term complement of sedation.

After anesthesia all children should be observed in the recovery room until they are fully conscious. In contrast to the adults, in children more common are critical situations what is mostly due to the immaturity of tissues and organs, anatomical and physiological differences that cause disturbances of the lung ventilation and an incorrect oxygenation.

While staying in the recovery room, patient's vital functions are monitored, and observation is carried out by an experienced anesthetic nurse. An anesthetist should be present or available if a critical condition or complications occur.

Statistically, in patients staying in the recovery room, critical situations or complications occur in 7%, i.e. in every 15 patients. Patients leave the recovery room after the complete return of consciousness, after examination performed by an anesthesiologist, which is noted in the patient record (time of discharge, patient's condition, doctor's signature and stamp).

Adequate preparation, anesthesia, transport and observation in the recovery room should guarantee that critical situations possible during anesthesia will not result in reversible or irreversible complications associated with anesthesia.