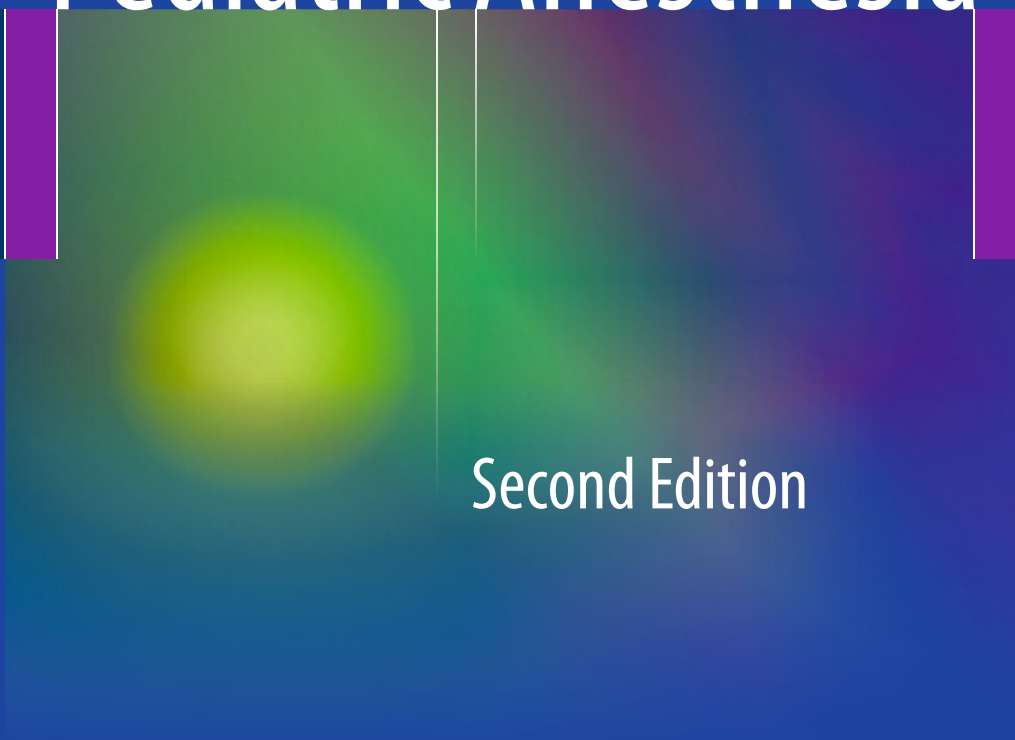
John G. Brock-Utne

Near Misses in Pediatric Anesthesia



Second Edition

Springer

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Foreword

After 40 years of working as an anesthesiologist, I occasionally fool myself into believing I have "seen it all." The truth: no one ever sees every possible clinical scenario. Unique presentations can occur whether it's your first day of anesthesia residency training or the last day of a long and eventful career. Only by sharing experiences can everyone learn from them. Dr. John Brock-Utne has had his share of unique cases. However, unlike most of us, he has recorded and collected them in this very useful book. Combining his talents as both a superb clinician and an award-winning teacher, he is able to describe a clinical situation, explain his thoughts in arriving at a diagnosis, and then describe how to apply the appropriate management. Thus, even after 40 years of practicing anesthesiology, I still continue to learn from him. Just as he has been a source of knowledge and information for me and the faculty and house staff at Stanford University, the reader can also now benefit from his knowledgeable and entertaining approach to the anesthetic management of unusual cases.

Stanford, CA, USA — Jay B. Brodsky

Preface to the Second Edition

Dear Reader,

Some of you may have read the first edition of *Near Misses in Pediatric Anesthesia*, published by Heinemann-Butterworth in 1999. I thought this would be the only edition. But thanks to Shelley Reinhardt, Senior Editor, Springer Science+Business Media, the first edition has been revived. This is therefore the second edition with 40 new additional cases. The original 47 cases have been revised and updated. I hope you will find the cases interesting and educational.

Again, each individual case starts with a short introduction. You are provided with the essential information to solve the problem. On the following page, you are given the solution and suggested management.

As with the first edition, the management of the cases may be controversial. Hence, I hope they will provide a basis for a discussion between a faculty member and an anesthesia resident, an anesthesia assistant, a CRNA, or a medical student as to other and possibly better alternative solutions.

Anesthesia has become much safer since I started my training in Oslo, Norway, on July 1, 1970. Now, 43 years later, I often cover up the anesthesia monitor, including information from the anesthesia machine about tidal volume, etc., when I work with new trainees. I say, "Now give the anesthetic. This is what it was like when I started." The response is utter disbelief. But the reason I do this is to stress the importance of examining your patients. This is especially true when the patient's vital signs are unstable. Remember not to solely rely on the monitors, as they are only an aid in your ongoing clinical assessment of your patient's well-being.

To paraphrase Hippocrates:

The art is long,
Life is short,
Experiments perilous,
Decisions difficult.

Stanford, CA, USA — John G. Brock-Utne

Preface to the First Edition

Anesthesiologists sometimes face difficult decisions in "near miss" situations. The risk-to-benefit ratios in these cases are often unknown. Fortunately, near misses occur rarely. The near misses reported in this book come mostly from my 30 years experience in clinical anesthesia in the United States, Scandinavia, and South Africa.

Each of the 47 cases starts with a short introduction to the clinical problem. The reader is provided with all the essential information necessary to prevent a disaster. The next page provides a solution and analysis of the problem, makes recommendations, and provides references for further reading.

Some of the sequences in the management of these cases may be controversial. As such, they may form the basis for a teaching discussion between a faculty member and a resident in anesthesiology. Most of all, the book is designed to alert the reader to various precarious situations that can arise and how best to prevent or deal with them. To paraphrase Hippocrates:

The art is long,
Life is short,
Experiments perilous,
Decisions difficult.

Stanford, CA, USA — John G. Brock-Utne

Acknowledgments

I would like to acknowledge my many colleagues around the world who have contributed to this book through our case reports and discussions regarding the many problematic cases:

Aitchison J, Andrews AD, Angelotti T, Barclay R, Bernstein O, Bland BAR, Bolton P, Bosenberg AT, Botz G, Brodsky JB, Brun C, Bushell E, Ceranski J, Chen K, Chu LF, Claure RE, Cochran M, Collins JS, DeBasttista C, Diachun CAB, Dimopoulos GE, Dow TGB, Downing JW, Eide AM, Eng MR, Fisher SP, Ganguly K, Giffard R, Habibi A, Haddow GR, Hammer G, Hester J, van der Heyden A, Hilton G, Hold AR, Holloway AM, Honkanen A, Humphrey D, Jaffe RA, Kim A, Krane EJ, Kingston HGG, Lemmens HJM, Lin YC, Lopes JR, Luckin P, Macario A, MacGillivray RG, Mallat AM, Mariano ER, Mark JB, Moll V, Moshal MG, Moynihan RJ, Naicker S, Naidu N, Naidu R, Odell JA, Pond D, Ratner E, Reid CS, Roberson J, Robins B, Robles B, Rubin J, Schmiesing CA, Sculte-Steinberg O, Silver L, Vogel T, Wang R, Welman S, Wu TT, and Zumaran AA.

I am also indebted to Dr. Jay B. Brodsky (Medical Director of the Stanford Operating Rooms) for kindly agreeing to write a foreword for this book; Dr. Richard A. Jaffe for his friendship and encouragement; Shelley Reinhardt, Joanna Perey, and Maureen Pierce (Springer) for all their help and support; and last, but not least, to my wife Sue, our three boys, their wives, and our five grandsons and one granddaughter.

John G. Brock-Utne

Contents

Chapter 1
Case 1: Upper Gastrointestinal Endoscopy Under General Anesthesia

A 23-month-old, previously healthy girl (16 kg) is scheduled for endoscopy and removal of an esophageal web. Her medical history is unremarkable except for mild dysphasia. Her vital signs are normal.

General anesthesia is induced via face mask using sevoflurane 1–4 % in nitrous oxide and 30 % oxygen after all necessary monitoring equipment is placed on the child. After the child is asleep, an intravenous (IV) line is inserted, and 0.15 mg atropine and 1.6 mg vecuronium are administered to facilitate tracheal intubation with a 5-mm internal diameter (i.d.) tracheal tube. Breath sounds are equal bilaterally, and a leak around the tube in the trachea is present at 20 cm H_2O peak inflation pressure. The endotracheal tube (ETT) is securely taped. The patient's lungs are hand ventilated using peak inspiratory pressures of 15–35 cm H_2O. The patient is draped from the neck down, and the endoscopist places the gastroscope into the esophagus without difficulty. A few minutes later, the lungs become less compliant, and the child's blood pressure (BP) decreases over a 5-min period from 90/50 to 70/35 mmHg. The electrocardiogram (ECG) is judged to be normal, and the heart rate increases from 110 to 130 beats per minute [1] (bpm) with a regular sinus rhythm. The capnograph demonstrates a CO_2 waveform. The shape has not changed; however, the peak airway pressure now increases from 22 to 38 cm H_2O. The peripheral oxygen saturation decreases from 100 % to 86 %. You do the following:

1. Increase the FIO_2 to 100 %.
2. Continue hand ventilation.
3. Ascertain the correct position of the ETT.
4. Pass a suction catheter successfully down the whole length of the ETT.

Question

No improvement is seen. What will you do, and what is the cause of the dilemma?

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Solution

The patient was undraped so her chest could be examined. The epigastrium was seen to be markedly distended. Unknown to the anesthesiologist, the endoscopist had injected air to dilate the esophagus and the stomach for better visualization. With gastric decompression, the patient's respiratory and cardiovascular parameters immediately returned to normal. The case proceeded without difficulty, and the patient made an uneventful recovery.

Discussion

This problem has been noted in both pediatric [1] and adult cases [2]. In the adult case, severe respiratory distress occurred during upper gastrointestinal endoscopy in a 30-year-old man. The procedure was performed under local anesthesia and sedation, and the cause of the respiratory distress was thought to be excess air insufflation into a stomach positioned within the chest through a hiatal hernia. The case reported here differs in that the patient was anesthetized with a normally positioned stomach. Excess insufflation of air into the esophagus dilated the stomach and markedly decreased chest compliance. The desaturation noted in this case most likely reflected the effect of ventilation/perfusion (V/Q) mismatch in a lung being compressed by a distended stomach.

Excessive gastric air insufflation has also been reported in neonates with tracheoesophageal fistulas, at times associated with cardiac arrest presumed secondary to the same mechanism [3]. Hence, use of a preoperative gastrostomy tube has been recommended in these cases to vent excess air.

This case would not have occurred had the anesthesiologist had the opportunity to observe the child's abdomen. It is not essential to cover patients for nonsterile procedures.

Recommendation

The epigastrium must be seen at all times during upper gastrointestinal endoscopy to prevent the possibility of excessive gastric distension.

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2. Narendranathan M, Kalam A. Respiratory distress during endoscopy—report of an unusual case. Postgrad Med J. 1987;6:805–6.
3. Baraka A, Slim M. Cardiac arrest during IPPV in a newborn with tracheoesophageal fistula. Anesthesiology. 1970;32:564–5.

Chapter 2
Case 2: Sudden Anesthesia System Failure

A 1-year-old patient, American Society of Anesthesiologists (ASA) physical status II, is to undergo removal of a cerebral tumor under general anesthesia. An anesthesia machine and breathing system check is performed before the patient's arrival. Noninvasive monitors are placed, and after preoxygenation the patient is anesthetized in a routine manner. Invasive monitors are placed, the operating table is turned 180°, and the operation begins. About 2 h into the operation, the surgeon requests that the operating table be elevated. Three to five minutes later, warning lights flash on the anesthesia machine (Narkomed 2 B, North American Drager). The warning indicates low minute volume, apnea, and no ventilation of the patient. The rotameters show adequate flow of oxygen and nitrous oxide, and the oxygen pipeline pressure is 50 psi.

Manual ventilation is attempted using the anesthesia machine's collapsible breathing bag but is unsuccessful because no air fills the bag despite using the oxygen flush control button. You do the following:

1. Provide self-inflatable bag ventilation. Confirm bilateral air entry. Keep the patient's oxygen saturation and vital signs stable.
2. Call for assistance.
3. Search for a cause of the breathing system failure in the anesthesia machine.

Question

You and your colleagues find nothing wrong with the machine. So what could be the cause of this dilemma?

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Solution

The cause of the acute distress was a kinked and compressed fresh gas flow tube between the railing of the operating room table and the bottom of the inspiratory pipe on the absorber (Fig. 2.1). This occurred when the operating table was raised [1].

Recommendation

The fresh gas flow tube from the anesthesia machine to absorber should always be short and not hanging loose. It should always be positioned behind the upright support brace (D) of the absorber, thereby preventing a kink in the tube.

A self-inflatable bag should be available in every operating room.

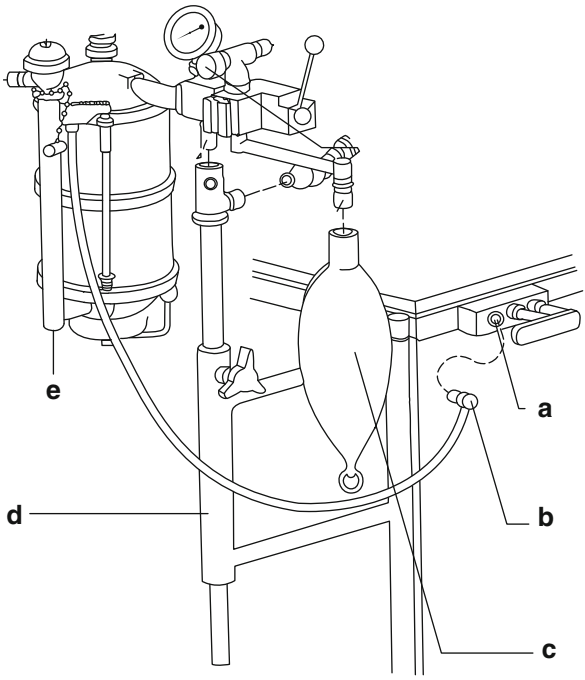

Fig. 2.1 (**a**) Fresh gas-locking device. (**b**) Fresh gas hose with 15-mm fitting. (**c**) Breathing bag. (**d**) Upright support brace. (**e**) Inspiratory pipe of the absorber

Reference

1. Silver L, Lopes N, Brock-Utne JG. Raising the operating table causing a sudden anesthesia system obstruction. Anesth Analg. 1996;82:1107–8.

Chapter 3
Case 3: Broviac Catheter Placement in a Neonatal Intensive Care Unit

A 43-day-old (1.3-kg) girl born at 27 weeks is scheduled for a Broviac catheter replacement in the neonatal intensive care unit (NICU). She is in the NICU because of respiratory failure, bronchopulmonary dysplasia, right lower lobe pneumonia, and sepsis. She has failed extubation twice in the past due to postextubation stridor and desaturation. The day before surgery, the patient was intubated with a 2.5 endotracheal tube (ETT) by the NICU staff and ventilated for 12 h before surgery. A large leak has been suspected around the endotracheal tube (ETT), as the nurse has noted hearing the patient cough and cry. At present, the ventilator is working and the settings include an FIO_2 of 30 %, respiratory rate of 14, and the pressure setting of 24/5. The patient's vital signs include a respiratory rate of 60, heart rate of 150 bpm, and oxygen saturation by pulse oximetry of 92–95 %. Her gastric tube is in place and open to air. Coarse breath sounds are heard bilaterally without evidence of leakage around the ETT. Standard monitoring devices are placed except for an end-tidal CO_2 monitor, which is not available. A preoperative radiography of the chest had been taken earlier in the morning but is unavailable for viewing.

Immediately after induction of anesthesia with intravenous (IV) pancuronium and fentanyl, the patient's oxygen saturation falls precipitously to 0, with a decrease in heart rate to the 1990s and with ST segment elevations. The patient is immediately ventilated via the ETT with 100 % oxygen. The breath sounds remain coarse and unchanged. A new pulse oximetry probe is placed by a nurse to rule out probe malfunction. There is no improvement in the oxygen saturation reading. No abdominal distension is noticed. IV atropine is administered to treat the bradycardia, and a call for help is made. Noninvasive blood pressure (BP) measurements remain within normal limits throughout this time. The heart rate responds to atropine, and the ST segment elevation partially resolves over the next minute.

Question

Oxygen saturation is still inadequate. What will you do now?

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Solutions

1. Perform a direct laryngoscopy to confirm correct placement of the ETT. In this case, the ETT is found to be in the esophagus. The ETT is placed in the trachea and the lungs ventilated with a rapid rise in oxygen saturation.
2. If the ETT was found to be in the trachea, transillumination of the chest with a torch could eliminate a possible pneumothorax.

Discussion

The preoperative detection of the esophageal-placed ETT proved elusive in this case [1]. Physical examination was not helpful in detecting esophageal intubation because the patient's breath sounds were transmitted throughout the thorax and abdomen. Even if we had reviewed the chest radiography preoperatively, we probably would have missed the esophageal positioning of the ETT because attention would have been focused primarily on the relative position of the tip of the ETT and the carina. Because the patient appeared to be adequately ventilated and oxygenated before induction of anesthesia, a pre-existing esophageal position ETT was not an obvious cause of postinduction desaturation.

Recommendation

Clamping or kinking the nasogastric tube while the patient was being ventilated with the intensive care unit (ICU) ventilator could have led to gastric distension within a few minutes. In our case, this was not done. We believe that the gastric distension was not seen because the patient's stomach was continuously decompressed by the nasogastric tube. The nasogastric tube therefore prevented a buildup of gastric pressure that could have led to an obvious degree of abdominal distension and the sounding of the high pressure alarm on the ventilator.

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Chapter 4
Case 4: Occluded Reinforced (Armored) Endotracheal Tube

An 8-year-old boy is presented for a major ear, nose, and throat (ENT) procedure. A reinforced endotracheal tube (ETT) (Mallinckrodt, St. Louis, MO) is used to secure the airway after induction of general anesthesia. Normally, these tubes are removed at the end of the procedure once the tracheostomy has been performed. In this case, however, due to surgical reasons, a tracheostomy is not done, and the patient is taken to the intensive care unit (ICU) with the reinforced ETT in place. You decide to leave the ETT in the trachea and to ventilate the child mechanically overnight because he exhibits marked head and neck edema after 10 h of surgery. The possibility of potential severe laryngeal edema makes you decide not to change the reinforced ETT with a standard ETT over a tube changer. The next morning, on awakening from the sedation, the patient bites down vigorously on the reinforced ETT. Due to the nature of the reinforced ETT, the lumen becomes completely occluded and will not re-expand. The patient cannot breathe nor can the lungs be ventilated. This results in oxygen desaturation to 80 %. Cyanosis becomes evident. The jaw can easily be opened.

Question

What will you do now?

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