Clinical Anaesthesia File

Anaesthetic management of an asthmatic child for appendicectomy

Case presented by

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A 13-yr-old boy was scheduled for emergency appendicectomy because of abdominal pain. His preoperative medical history was complicated by a recent hospital admission for management of asthma. He had presented to hospital seven days earlier because of dyspnoea, tachypnoea and oxygen desaturation to 77% on room air. Following admission, he required intensive non-ventilatory management of his asthma, including intravenous salbutamol, methylprednisolone, and aminophylline, as well as use of an ipratropium bromide inhaler and 100% oxygen by mask. He was discharged to the ward, and continued on prednisone (deltacortisone), beclomethasone inhaler, ipratropium inhaler, and salbutamol inhaler. During his ICU stay, he complained of nonspecific abdominal pain, interpreted as gastro-oesophageal reflux. After four days, he was discharged to the ward. On his sixth hospital day, he began to experience right-sided lower abdominal pain and right shoulder pain. A surgeon was consulted, and the patient was found to have a very tender right lower quadrant with guarding and rebound pain. He was therefore scheduled for appendicectomy; antibiotic therapy with ampicillin, gentamicin, and metronidazole was initiated.

Un enfant de 13 ans souffrant de douleurs abdominales est programmé pour une appendicectomie d'urgence. Son histoire révèle qu'il a été hospitalisé peu de temps auparavant pour une crise d'asthme. En effet, sept jours plus tôt, il est admis à l'hôpital avec de la dyspnée, de la tachypnée et une désaturation en oxygène de 77% à l'air ambiant. Après son admission, il est traité aux soins intensifs, sans ventilation mécanique, mais par l'administration intraveineuse de salbutamol, de méthylprednisolone et d'aminophylline, l'inhalation de bromure d'ipratropium et de l'oxygène à 100% au masque. Après son retour au service, il continue son traitement avec de la prednisone (deltacortisone), et des inhalations de béclo-méthasone, d'ipratropium et de salbutamol. Pendant son séjour aux soins intensifs, il s'était plaint d'une douleur abdominale haute non spécifique attribuée à un reflux gastro-

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COMPLICATIONS: asthma.

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oesophagien. Quatre jours plus tard, il est ramené au service. Le sixième jour de son hospitalisation, il dit ressentir une douleur abdominale basse du côté droit et une douleur à l'épaule droite. Un chirurgien consulté constate que le patient présente une sensibilité douloureuse du quadrant inférieur droit avec défense et une douleur à la décompression lors de la palpation abdominale. Il est alors programmé pour une appendicectomie et on commence un traitement à l'ampicilline, la gentamycine et le métronidazole.

Past medical history included five previous admissions to hospital for treatment of acute asthma. He had no previous surgery, and his only allergies were to dogs and horses. His usual medications at home were salbutamol and beclomethasone inhalers.

This patient has several factors complicating the management of his abdominal pain. First, he is suffering from a recent exacerbation of his asthma. Second, he has abdominal pain associated with right shoulder pain. Third, he has been chronically using inhaled steroids for management of his asthma and recently has been receiving large doses of methylprednisolone, followed by prednisone for seven days.

The administration of general endotracheal anaesthesia to a patient who has had a recent acute asthmatic attack is associated with potential precipitation of bronchospasm, difficult ventilation, hypoxia, and pneumothorax. In this emergency situation, it is extremely important to assure that the patient's present bronchodilator therapy has been optimized, and that he receives appropriate preoperative treatment. Preoperative consultation by a pulmonary physician would be appropriate.

Abdominal pain with associated shoulder pain is an ominous sign, as it frequently indicates diaphragmatic irritation. In this instance, it may portend the diagnosis of peritonitis. The likelihood of peritonitis in the presence of appendicitis is higher in this instance because adrenal steroid therapy diminishes the symptoms produced by inflammation. Any acute inflammation may arise, with either localized or generalized peritonitis, without the usual symptoms and signs of such inflammation being sufficiently clear to cause alarm.¹ Peritonitis may complicate the management of asthma because of the possibility of dehydration – if this patient is dehydrated, airway secretions become thick and inspissated, increasing small airway closure.

The use of systemic steroids is also associated with adrenal suppression and the inability to mount a physiological response to the stress of surgery. In this instance, the patient was on inhaled beclomethasone before admis-

sion and had been receiving high-dose steroids for seven days. Consideration must be given to administering a prophylactic steroid bolus preoperatively.

Before scheduling surgery, the patient was being followed by a pulmonary consultant, who recommended an additional dose of beclomethasone, ipratropium, and salbutamol. Methylprednisolone 30 mg *iv* was administered.

Physical examination immediately preoperatively revealed an obviously uncomfortable patient. His temperature was 36.2°C, pulse rate 97 bpm, respirations 36 · min⁻¹, and weight 60 kg. He was complaining of right shoulder pain and abdominal pain. On chest examination, rhonchi were heard on the right side with forced expiration. On examination of the abdomen, the patient was exquisitely tender on the right side. The patient stated that his asthma had improved since admission but that he was not yet back to his "usual" state.

Chest x-ray demonstrated perihilar bronchial wall thickening only: white blood count was 14.2 cells · 10⁹ · L⁻¹. Recent pulmonary function tests and blood gases were not done, but peak expiratory flows and oxygen saturation on room air were both within normal limits on discharge from ICU.

At this point, there are a limited number of options regarding anaesthetic management. It is evident that the patient is in the best possible medical condition, from the pulmonary point of view, that can be expected. Regardless, the risks of general anaesthesia are high because he would require tracheal intubation following a rapid-sequence induction. Although he has recently recovered from acute asthma, his airway reactivity is expected to be substantial, and he is at considerable risk of developing intraoperative and postoperative pulmonary complications. The risks of regional anaesthesia may be less.

If general anaesthesia is the chosen option, careful monitoring of ECG, blood pressure, oxygen saturation, end-tidal CO₂, neuromuscular blockade, breath sounds, and ventilatory pressure is important. Agents which are sympathomimetic or which enhance bronchodilatation are indicated. A well-sedated and deeply anaesthetized patient should experience less coughing, airway irritation, and bronchospasm. Preanaesthetic sedation with midazolam *iv* and/or fentanyl should be considered. Following preoxygenation and lidocaine 1 mg · kg⁻¹, *iv* a rapid sequence induction with ketamine and succinylcholine would be effective. Maintenance agents which would be effective would be halothane or isoflurane (for bronchodilatation and deep anaesthesia), fentanyl and nitrous oxide for analgesia, and pancuronium for muscle relaxation.

Regional anaesthesia is a reasonable option for intraoperative anaesthetic management of this individual – either spinal anaesthesia or epidural anaesthesia. Regardless of the modality used, the patient would require verbal support, sedation, and careful monitoring of pulse, blood pressure, temperature, oxygen saturation, and ventilation. Spinal anaesthesia is less controllable in the level of blockade obtained, and has a limited duration of anaesthesia unless a continuous spinal catheter is used. Epidural anaesthesia level is more controllable, block intensity should be adequate using lidocaine 1.5%, and duration may be unlimited if a continuous catheter is used. One potential disadvantage to the use of a continuous catheter is the possibility of providing a focus for infection, should the patient experience septicaemia. For this reason, continuous postoperative epidural analgesia would not be recommended.

Regardless of the anaesthetic technique chosen, management of postoperative pain would be most effective using intravenous fentanyl (or morphine, if tolerated by this patient) by continuous infusion or by Patient Controlled Analgesia.

Actual course

After discussing the risks and benefits of anaesthetic alternatives with the parents, child, and surgeon, it was agreed that an epidural anaesthetic would be used, provided that the patient was sedated and comfortable. Following sedation with midazolam 5.5 mg *iv* in divided doses, and application of appropriate monitors, an epidural catheter was inserted at the T₁₂–L₁ level. Lidocaine 1.5% in divided doses up to 18 ml was then administered. When sensory block of T₇ to L₂ was attained and measured using a nerve stimulator, the surgery began. The patient was found to have peritoneal soiling – the retrocaecal appendix was ruptured. During the procedure, gentle peritoneal lavage was required, and some discomfort was experienced by the patient, described as pressure on his abdomen. An additional 13 ml lidocaine 1.5%, fentanyl 15 µg, and cyclizine 20 mg *iv* (for nausea) were given. The patient was talking intermittently throughout the procedure, and was transferred to the recovery room one hour and 30 min after initiation of the epidural anaesthetic. He was given an additional epidural bolus of fentanyl 40 µg and bupivacaine 0.125%, 10 ml before removal of the epidural catheter in the recovery room. Postoperatively, his oxygen saturation was 87% breathing room air, and he complained of some difficulty in breathing. He improved with the administration of salbutamol inhalation and oxygen by nasal prongs. A continuous morphine infusion was started six hours postoperatively.

Discussion

Asthma is a syndrome characterized by increased responsiveness of the tracheobronchial tree to a variety of stimuli. Patients with asthma have an exaggerated response to physical, chemical, and pharmacological stimuli. This exaggerated response to stimuli is found in 100% of patients with symptomatic asthma, the situation described in this patient with appendicitis.

The primary stimulus to precipitate intraoperative bronchospasm is irritation by an endotracheal tube. Therefore, if intubation is required, precautions must be taken to anticipate the irritation by administering agents which block the reflex bronchospasm. Lidocaine given prior to intubation in a dose of 1–2 mg · kg⁻¹ *iv* may prevent reflex bronchoconstriction associated with instrumentation of the airway. Aerosol administration² may provide no advantage over the intravenous route³ and may even provoke bronchoconstriction. Ketamine has been shown to inhibit vagal pathways, to provide direct relaxation of the airway smooth muscles and to increase endogenous plasma catecholamine concentrations which relax the airway via β₂-adrenoceptors on airway smooth muscle.⁴ Although both isoflurane and halothane are acceptable alternatives as bronchodilators for maintenance of anaesthesia, halothane at low concentrations has been shown to be a much better bronchodilator than isoflurane.⁵ Because there are fewer airway problems with halothane⁶ and because it is a better bronchodilator, halothane is more commonly used for paediatric patients with asthma. Many neuromuscular agents are capable of inducing histamine release from mast cells, and they can potentially increase airway tone – those agents are therefore best avoided in asthmatics. Pancuronium, likely because of its sympathomimetic properties, is associated with less airway resistance than d-tubocurarine in subjects with pre-existing lung disease, and is the muscle relaxant of choice in patients with asthma. Because asthmatics react with bronchoconstriction to very low concentrations of histamine, narcotics that do not have histamine-releasing properties might be preferable, but the preference of morphine over fentanyl is controversial. Generally, in managing asthmatic patients with endotracheal anaesthesia the anaesthetic plan must include choices of agents that will specifically reduce airway reactivity.

Although the chronic use of systemic steroid therapy is associated with adrenal insufficiency, this is not the case with the use of inhaled steroids for asthma.⁷ For that reason, perioperative steroid supplementation for stress is not required for asthmatics receiving inhaled beclomethasone only. In this instance, the use of methylprednisolone was principally for its antiinflammatory effects in anticipation of intraoperative or postoperative bronchospasm.

Regional anaesthesia is frequently used in paediatric anaesthesia practise, but usually patients are asleep while needles are inserted. Adolescents, however, are acceptable candidates for regional anaesthesia without general anaesthesia in specific circumstances. In all situations where there is high risk of complications associated with the administration of a general anaesthetic, a regional anaesthetic technique should be considered.

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