



Perioperative Anaesthetic Approach in a Homozygous Sickle Cell Anaemia Patient with Frequent Pain Crises

Çok Sık Ağrılı Kriz Geçiren Homozigot Orak Hücreli Anemili Hastada Perioperatif Anestezi Yaklaşımı

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Sickle cell disease (HbS) is a haemolytic anaemia characterized by the formation of abnormal haemoglobin. In patients with sickle cell disease, high rates of erythrocyte generation, degradation, and hyperbilirubinemia increase the risk for cholelithiasis. Previous studies have found that the incidence of cholelithiasis is 70% in adult patients. In sickle cell disease, decreased oxygen concentration leads to the sickling of erythrocytes by causing aggregation and polymerization. Sickling erythrocytes can have devastating effects on many vital organs by causing microvascular occlusion. In patients with sickle cell anaemia, anaesthetic technique, anaesthetic agents, and surgical trauma may cause additional risk. In this case report, we present a perioperative anaesthetic approach in the laparoscopic cholecystectomy of a patient with HbS, elevated liver function tests, and frequent pain crises.

Key Words: Sickle cell anemia, anaesthesia, laparoscopic cholecystectomy

Orak hücreli anemi hastalığı (HbS), anormal hemoglobin oluşumu ile karakterize kalıtsal hemolitik bir anemidir. Bu hastalarda eritrositlerin yüksek oranda yapımı, yıkımı ve hiperbilirubinemi kolelitiazis riskini artırır. Yapılan çalışmalarda kolelitiazis görülme sıklığının yetişkinlerde %70 oranında olduğu bildirilmiştir. Orak hücreli anemi hastalığında düşük oksijen konsantrasyonları, hemoglobinde agregasyona ve polimer oluşumuna yol açarak eritrositin oraklaşmasına neden olur. Oraklaşmış eritrositler mikrovasküler tıkanmalara yol açarak çok sayıda hayati organlarda yıkıcı olaylara neden olabilirler. Bu hastalarda kullanılan anestezi yöntemi, anestetik ajanlar ve cerrahi travma ek riske neden olabilir. Bu olgu sunumunda çok sık ağrılı krizler geçiren, karaciğer fonksiyon testleri yüksek HbS'li hastada laparoskopik teknikte yapılan kolesistektomi operasyonunda perioperatif anestezi yaklaşımı sunulmuştur.

Anahtar Kelimeler: Orak hücreli anemi, anestezi, laparoskopik kolesistektomi

Introduction

Sickle cell disease (HbS) is an inherited haemolytic anaemia characterized by the formation of abnormal haemoglobin. In HbS, glutamic acid is replaced by valine at the sixth position of the β -globulin chain, differing from normal adult haemoglobin (HbA). This abnormality causes aggregation and polymerization of haemoglobin (in the case of decreased oxygen concentrations), leading to the sickling of erythrocytes. Sickling erythrocytes can have devastating effects on many vital organs, including the central nervous system, the spleen, the kidneys, the lungs, and the heart, by causing micro-vascular occlusion (1). Due to several reasons, the anaesthetic technique, the anaesthetic agents used (when needed), and surgical trauma may pose additional risks (2, 3).

In this case report, we present a perioperative anaesthetic approach used in the laparoscopic cholecystectomy of an HbS patient with frequent pain crises and increased liver function tests who gave informed consent.

Case Presentation

A 32-year-old man weighing 73 kg complained of right hypochondrium pain that increased after eating and eructation for a period of 1 month. The patient was diagnosed to have cholelithiasis, and a laparoscopic cholecystectomy operation was scheduled. He gave written informed consent before surgery. His history revealed that he had been treated for sickle cell anaemia, had three painful crises within the last 3 weeks, and had undergone two surgeries due to urethral trauma. In the pre-operative evaluation, the patient's vital signs were stable, and there was tenderness in the right subcostal region (but not rebound tenderness or defense). The skin was observed to be icteric. An abdominal sonography revealed hepatomegaly,

Table 1. Blood biochemical tests

	AST (U L ⁻¹)	ALT (U L ⁻¹)	T. BIL (mg dL ⁻¹)	D. BIL (mg dL ⁻¹)	GGT (U L ⁻¹)	LDH (IU L ⁻¹)	ALP (U L ⁻¹)	K (mmol L ⁻¹)
Preop	98	46	5.9	3.7	60	491	219	5.2
Postop (1 st day)	68	36	6.1	3.4	55	332	144	4.3

AST: aspartate aminotransferase; ALT: alanine aminotransferase; T. BIL: total bilirubin; D. BIL: direct bilirubin; GGT: gamma-glutamyl transpeptidase; LDH: lactate dehydrogenase; ALP: alkaline phosphatase; K: potassium; Preop: preoperative; Postop: postoperative

Table 2. Haemoglobin electrophoresis test and Haemogram parameters

	Hb S (%)	Hb A (%)	Hb A2 (%)	Hb F (%)	Hb (g dL ⁻¹)	HTC (%)	WBC (10 ³ µL ⁻¹)	PLT (10 ³ µL ⁻¹)
Pre-transfusion	78.6	5.9	3.5	3.7	7.6	22	9.10	185
Post-transfusion	31.6	52.9	3	1.6	11.1	32	7.60	256

Hb: hemoglobin; HTC: haematocrit; WBC: white blood cell; PLT: platelet

autosplenectomy, sludge in the gallbladder, and cholelithiasis. The transthoracic echocardiography revealed that the ejection fraction was estimated to be 50%, and the pulmonary artery pressure was measured as 30 mm Hg. The intracardiac valves and movements of the ventricular walls were found to be normal. Elevated liver enzyme and bilirubin levels were found in the preoperative screening tests (Table 1). The Hb value was measured to be 7.6 g dL⁻¹. An exchange transfusion was planned, because the haemoglobin electrophoresis test revealed the patient's HbS to be 78.6%. After the exchange transfusion, the patient's Hb and HbS values were 11.1 g dL⁻¹ and 31.6%, respectively (Table 2).

Pre-operatively, the patient was ordered to fast for 6 hours, and a normal saline infusion (2 mL kg⁻¹ hour⁻¹) was initiated the night before the surgery. The patient was preoxygenated for 3 minutes before induction. Anaesthesia induction was achieved with intravenous administration of 50 µg fentanyl, 150 mg propofol, and 10 mg cisatracurium. Then, the patient was given 100% O₂ for 2 minutes via a face mask. Endotracheal intubation was performed using an intubation tube with an inner diameter of 8 mm. Controlled ventilation was initiated with the following ventilator settings: tidal volume: 7 mL kg⁻¹; respiration rate: 12 min⁻¹; and alarm limit of airway pressure: ≤30 cm H₂O. It was aimed to maintain end-tidal CO₂ pressure at 30-35 mm Hg. Anaesthesia was maintained with sevoflurane 2% and oxygen 50% in the air. After the intubation, the patient was moved from the supine position to the Fowler position (30°-40°). The surgical team inserted a Veress needle and a trochar into the peritoneal cavity. The CO₂ pneumoperitoneum was achieved with an intra-abdominal pressure of 13-14 mm Hg via CO₂ insufflation (intraperitoneal rate: 4-6 L min⁻¹). During surgery, the patient was placed in the Trendelenburg position. The ventilator settings were revised to prevent hypercapnia due to pneumoperitoneum and the Trendelenburg position: tidal volume: 8 mL kg⁻¹ and respiration rate: 14 min⁻¹. The blood gas values were monitored, and no impairment was observed

in haemodynamic and oxygenation during surgery. The duration of the surgery was 80 minutes. For post-operative analgesia, 1 g of paracetamol and 50 mg of tramadol were given intravenously 15 minutes before the extubation. The patient was discharged on the second day after surgery, as he did not exhibit elevation in the liver enzyme tests during the post-operative period.

Discussion

Patients with sickle cell anaemia have four different genotypes, including sickle cell anaemia (homozygous HbS), sickle cell carrier (heterozygous), sickle haemoglobin C disease (SC), and sickle β-thalassemia (S/β⁰ or S/β⁺ thalassemia). The clinical findings are worse in patients with homozygous HbS or HbS/β⁰ when compared to other forms; the pain crises are more severe and frequent in these patients (4).

Symptoms of sickle cell anaemia may occur in any organ. The most common clinical finding is pain. Potential crises in these patients include splenic sequestration, aplastic anaemia, right upper quadrant syndrome, and acute chest syndrome (5). In patients with sickle cell anaemia, pain crises are the result of infarctions caused by sickling in various tissues. In these patients, abdominal pain can mimic acute abdomen. Thus, it is difficult to determine whether or not the situation requires surgical intervention. In the literature, elective cholecystectomy is recommended for sickle cell anaemia cases with cholelithiasis (2, 6).

Cholecystectomy, liver biopsy, splenectomy, tonsillectomy, hip prosthesis, and obstetric procedures are the most commonly performed surgical interventions in patients with sickle cell anemia. The anaesthesiologist, haematologist and surgeon should assess the patients with sickle cell anaemia who are scheduled for elective surgeries together. In the pre-operative evaluation, haemoglobin and haematocrit measurements, haemoglobin electrophoresis, and electrocardiography (ECG), echocardiography and chest radiograph for cardiopulmonary dysfunction, measurements of blood urea

nitrogen (BUN), creatinine, serum electrolyte levels for renal dysfunction, and measurements of aspartate aminotransferase (AST), alanine aminotransferase (ALT), platelet count, prothrombin time (PT), partial thromboplastin time (PTT) and fibrinogen levels for hepatic dysfunction and cranial magnetic resonance imaging (MRI) and transcranial Doppler sonography for neurological dysfunction should be performed (5). In such cases, adequate hydration should be provided; infection risk should be eliminated, particularly for operations involving the respiratory system, and nutritional deficiency and anaemia should be corrected before surgery. Moreover, it is recommended that intensive pre-medication should be avoided due to the risk of hypoxia, as mentioned in the literature (1, 7).

In cases with sickle cell anaemia, blood transfusions not only correct chronic anaemia, they also suppress erythropoiesis involving cells containing HbS in bone marrow; thus, cells containing HbA become dominant. This provides a safety network when a situation triggering sickling of the cells becomes apparent (1). Thus, an exchange transfusion was performed on our patient to combat the sickling that causes frequent pain crises before surgery. However, it has been reported that small-volume blood transfusions are also effective and lower the risk of transfusion reaction. In addition, haemoglobin and haematocrit values not exceeding 11 g dL⁻¹ and 30% are recommended to avoid increased blood viscosity (2, 8, 9).

In cases with sickle cell anaemia, the normal lifespan of an erythrocyte (120 days) may drop to as low as 12-17 days. The higher rates of erythrocyte generation, degradation, and hyperbilirubinemia increase the risk for cholelithiasis (2). Previous studies have reported that the incidence of cholelithiasis is 70% in adult patients (3, 9). Other commonly observed conditions in sickle cell anaemia include pulmonary dysfunction, renal failure, myocardial infarction, priapism, stroke, aseptic necrosis of bone and joints, ischemic ulcers, ocular findings, and complications of repeated blood transfusions. The most common cause of death is infection (33%-48%) in these patients. Infections most frequently involve the respiratory system (72.6%). There is no specific treatment modality yet. These patients should be vaccinated with pneumococcal vaccine, and penicillin prophylaxis should be implemented. Hydroxyurea should be given to improve haemoglobin F production and to decrease the likelihood of sickling. Patients undergoing frequent blood transfusions should be closely monitored for iron accumulation. Many patients can live until the fifth or sixth decade. In recent years, bone marrow transplantation seems to be a promising treatment approach (5, 10).

In our case, a laparoscopic cholecystectomy was performed under general anaesthesia. No elevation was observed in liver enzymes during the post-operative period. In the literature, it has been reported that agents used for anaesthesia have no direct effect on sickling (5) and that any anaesthetic technique

can be successful when hypothermia, hypoxia, hypovolemia, hyperviscosity, acidosis, and hypotension are avoided (2, 4, 6). For liver diseases, regional anaesthesia is recommended to avoid the hepatotoxic effects of general anaesthetics (in cases with normal prothrombin time, international normalized ratio (INR), and platelet counts) (11). However, another study suggests that local stasis occurring during high spinal anaesthesia is one of the factors that enhances sickling, meaning that general anaesthesia is more advantageous than spinal anaesthesia in cases with severe anaemia (12). Use of a tourniquet is not recommended, as it causes local stasis and acidosis. However, if use of a tourniquet is warranted, the relevant extremity should be cleared carefully of blood, and cuff inflation time should be minimized (4).

In cholecystectomy surgery, complications related to sickle cell anaemia are similar in both laparoscopic and open techniques. In the laparoscopic technique, although the duration of anaesthesia is prolonged, the length of the hospital stay is shortened; thus, the laparoscopic cholecystectomy technique is preferred to an open cholecystectomy in cases with sickle cell anaemia (6, 9). However, in the laparoscopic technique, peritoneal CO₂ insufflation and the Trendelenburg position can cause hypercapnia if minute ventilation is not increased by 20%-30% (13, 14). In our patient, we increased the tidal volume and the ventilation frequency once CO₂ pneumoperitoneum was established.

In patients with sickle cell anaemia, normothermia, early mobilization, and oxygen supplementation are recommended for the post-operative period (1, 6). In these patients, post-operative pain should be well controlled. Regional techniques can be used for analgesia; however, vasoconstrictor agents, such as adrenaline, should not be added to the local anaesthetic. In general, it has been recommended to use a patient-controlled analgesia method and opiate and non-opiate analgesics in combination. Thereby, opiates can be titrated and used in reasonable doses, avoiding excessive sedation (2, 4, 6). Patients should be closely monitored for pulmonary complications in the postoperative period. Aggressive oxygen supplementation should be implemented, as hypoxemia can be a primary trigger of acute chest syndrome. Acute chest syndrome developing in the early postoperative period causes severe morbidity and mortality (5).

Conclusion

In conclusion, we think that the laparoscopy technique under general anaesthesia is safe in sickle cell anaemia cases scheduled for cholecystectomies with frequent pain crises and elevated hepatic function tests, assuming that blood transfusions and adequate hydration are provided and that complications triggering perioperative and post-operative sickling are avoided.

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