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Case Report
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Pulmonary Embolism During Hepatoblastoma Resection

Alkin Çolak[1], Ümit Nusret Başaran[2], Elif Çopuroğlu[1], Fatih Sağ[1], Zafer Çakıcı[1], Güven Kıray[1]
[1]Department of Anaesthesiology and Reanimation, Trakya University School of Medicine, Edirne, Turkey
[2]Department of Pediatric Surgery, Trakya University School of Medicine, Edirne, Turkey

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Abstract

Although hepatoblastoma is rare, it is the most malignant tumour of childhood. Treatment is usually done by surgical resection and chemotherapy. The mortality and morbidity have decreased due to improvements in the treatments. In this process, hepatic resection has a risk of pulmonary embolism, and this condition could be fatal. In this case, a 9-month-old patient who was treated with chemotherapy and then underwent hepatectomy was presented. We used non-invasive methods such as the perfusion index (PI), the plethysmographic variability index (PVI) (Massimo Radical 7) and non-invasive total haemoglobin measurement (SpHb) rather than invasive measurements. During closure of the surgical skin incision, the end-tidal CO_2 ($ETCO_2$) value dropped, after which arrhythmia and bradycardia resulted in cardiac arrest. Cardiopulmonary resuscitation (CPR) was initiated. However, the patient did not respond to CPR. We concluded that heparin may be administered to reduce the risk of thrombosis in patients undergoing liver surgery.

Keywords: Heart arrest, hepatoblastoma, pulmonary embolism

Introduction

Hepatoblastoma is the most common malignant liver tumours in childhood (1). In recent years, as a result of advances in surgical resection and progress in the field of chemotherapy, overall survival rates have increased from 30% to 80% (2). Liver resection is one of the major surgical treatment procedures, which carries a risk of pulmonary embolism (3). Pulmonary embolism is a fatal clinical condition, but can potentially be reversed by early intervention. In this article, we present a case of sudden cardiac arrest during the closure of the surgical skin incision.

Case Presentation

A 9-month-old female infant weighing 6000 g was diagnosed with hepatoblastoma. The parents provided consent for the surgery and for the reporting of this case. She previously had a heterogeneous mass in her right liver lobe that was 104x93x141 mm in size at 5 months. The patient was diagnosed with hepatoblastoma by liver needle biopsy, which was accepted as being at an advanced stage according to the recommendations of the International Childhood Liver Tumours Strategy Group (SIOPEL), since it was observed to be passing through the midline. Four cycles of chemotherapy (cisplatin 80 mg m^{-2}, carboplatin 500 mg m^{-2} and doxorubicin 60 mg m^{-2}) were administered to the patient. After chemotherapy, a reduction in the size of the liver mass (92x85x63 mm) was detected and the patient was scheduled to undergo right hepatectomy. At the operation table, electrocardiography (ECG), non-invasive blood pressure and peripheral oxygen saturation and non-invasive total haemoglobin measurement (SpHb), the perfusion index (PI) and the plethysmographic variability index (PVI) (Massimo Radical 7) were performed. For induction of anaesthesia, 20 mg propofol, 2.5 mg rocuronium and 5 µqr fentanyl were administered. Sufficient muscle relaxation was followed by intubation with 3.5 mm uncuffed endotracheal tube. Anaesthesia was maintained with 2%–3% sevoflurane+O2+air. An oxygen saturation level of 98%–100% was allowed. When necessary, 0.5 mg kg^{-1} rocuronium was administered. Mechanical ventilation was adjusted to an end-tidal CO_2 ($ETCO_2$) level of

Corresponding Author: Alkin Çolak E-mail: alkincol@yahoo.com

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30–35 mmHg. Fluid therapy was performed according to PI and PVI values with a balanced electrolyte solution. A total of 350 ml of crystalloid fluid infusion was used during the operation. The total bleeding amount was calculated as 150 ml in the intraoperative period. Non-invasive haemoglobin levels with a reduction of 0.5 g dL^{-1} were followed by transfusion. A total of 110 cc of erythrocyte suspension was used during the operation. During the third hour of anaesthesia, at the time of the closure of the surgical skin incision, the ETCO2 value was measured as 25 mmHg and 21–18 mmHg, respectively. After arrhythmia and bradycardia resulted in cardiac arrest, inhalation anaesthesia was discontinued and cardiopulmonary resuscitation (CPR) was initiated. CPR was terminated after 56 minutes and the patient was accepted as exitus.

Discussion

Hepatoblastoma is a liver tumour of embryonal origin. Approximately 70%–75% of all primary liver tumours are constituted (4). The mean age of diagnosis was reported as 19 months, and it was 3/1 times more common in boys than most childhood cancers. As the disease can be seen sporadically, the Beckwith-Wiedemann syndrome may be associated with familial adenomatous polyposis syndromes. The aim of treatment is to remove the tumour tissue until the surgical margin is clean (1).

Systemic venous air embolism in liver surgery can lead to serious cardiovascular deterioration for the patient (5). $ETCO_2$ has been reported to be a rapid, safe and valid test used to exclude suspected pulmonary embolism (6, 7).

It has been shown that the $ETCO_2$ value does not exceed 32.3 mmHg in patients diagnosed with pulmonary embolism (6). In our case, when the $ETCO_2$ value was in the normal range, it suddenly decreased to 25 mmHg and interpreted the pulmonary embolism. Although there was a risk of air embolism in liver surgery, worsening of the patient's condition did not occur during liver resection, and acute decrease in ETCO2 was observed at the time of the surgical skin closure. This situation suggests that the aetiology is more in the direction of thromboembolism rather than air embolism.

The so-called Virchow's triad, i.e. venous stasis, hypercoagulation and endothelial damage are generally responsible for the formation of venous thromboses. To reduce central venous pressure and bleeding in the liver resection, putting a clamp on the inferior vena cava is a risk factor for pulmonary thromboembolism (8).

In our case, the venous structures between the vena cava and the liver were subjected to prolonged pressure during surgery. In this process, the vascular endothelial injury was triggered and blood flow in these veins was exposed to stasis. In addition, due to hepatic involvement in hepatoblastoma cases, imbalances in the coagulation cascade were inevitable. The embolism that occurred during liver resection was interpreted as the formation of thromboembolism from the venacaval system that returned to the physiological flow pattern after the surgical controls to the pulmonary bed were applied.

There is a high risk of thrombosis in liver surgery. Different doses of heparin are usually used to prevent thrombosis. It has been found that low-dose heparin reduces the occurrence of thrombosis without increasing the risk of bleeding during living donor hepatectomy (9). In our case, if we had administered low-dose heparin, we would not have encountered such a complication.

Perfusion index and PVI are a dynamic measurement method for proper fluid replacement in mechanically ventilated patients during anaesthesia. It is preferable to avoid these invasive applications in large surgical procedures during non-invasive treatments and continuous demonstration of this method (10). In our case, we managed fluid replacement by using these methods.

In patients with pulmonary embolism under anaesthesia, ECG findings commonly include sinus tachycardia and a normal ECG pattern. In addition, atypical arrhythmias can be seen such as right ventricular strain pattern and right axis deviation due to increased pulmonary artery pressure (11).

In our patient, a decrease in $ETCO_2$ was followed by a short period of arrhythmia and bradycardia and her electrocardiography findings indicated asystole afterward.

Conclusion

In order to reduce the risk of thrombosis in patients undergoing liver surgery, attention should be paid to monitoring the values of $ETCO_2$ and the administered heparin.

Informed Consent: Written informed consent was obtained from patients' parents who participated in this case.

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