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CASE REPORT

Intraoperative Right Ventricular Myocardial Infarction in a Geriatric Patient with Hip Fracture: a Case Report

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HIP fracture is becoming a global public health issue due to increased longevity and the increased incidence of osteoporosis.^{1,2} Patients who underwent surgery experience high rates of mortality and disability, with approximately 5% death rate before discharge and 10% death rate within 30 days after discharge.^{3,4} Intraoperative cardiac arrest (IOCA) complicates up to 43 per 100,000 surgeries.⁵ Even with resuscitation by eligible professionals in a well-equipped operating room, IOCA is still associated with 35% immediate mortality and 65.5% in-hospital mortality.^{6,7} The main causes may be related to patient conditions, preoperative complications, anesthesia or surgical procedures.^{7,8} Age-associated changes in cardiovascular and other systems especially increase the risk of IOCA, which may explain why geriatric patients are the majority who experience asystole during surgery.

Right ventricular myocardial infarction (RVMI) rarely occurs in isolation. One-half of RVMI cases accompany inferior wall ischemia. Clinical consequences of RVMIs vary from no hemodynamic change to severe hypotension or cardiogenic shock. Our report describes a geriatric patient who suffered from RVMI that led to cardiac arrest during general anesthesia in an orthopedic surgery.

CASE DESCRIPTION

A 74-year-old male (height 170cm, weight 80kg) was scheduled for total hip replacement due to Left femoral neck fracture. He had history of head surgery ten years ago for cerebral embolism without any sequelae. He claimed no history of cardiac disease. Preoperative electrocardiogram showed a sinus rhythm, no evidence of ischemia or infarction. Laboratory results of blood routine examination and coagulation profile were normal. The patient didn't have echocardiography or coronary artery computerized tomographic angiography before the surgery. No cardiologic consultation was ordered.

Atropine(0.5mg) was delivered intramuscularly as pre-operative medication before the patient entering the operating room, and vital signs were measured immediately thereafter. His blood pressure (BP) was 185/102 mmHg, heart rate (HR) was 81 beats/min, and pulse oximetry oxygen saturation (SpO₂) was 98%. After intra-venous administration of 2μg sufentanil and 2mg midazolam, his blood pressure dropped to 145/85 mmHg. A Cordis was inserted into the right internal jugular vein, and an arterial catheter was placed into the left radial artery for monitoring central venous pressure and arterial blood pressure respectively.

We induced general anesthesia using sufentanil (20μg), etomidate (8mg) and rocuronium (48mg) with orotracheal

intubation. As the surgery proceeded, the patient's vital signs was maintained at ABP 120/80 mmHg, CVP 6 cmH₂O, HR 80 beats/min, and SpO₂ 100%. Forty minutes later, the patient's CVP suddenly augmented to 14 cmH₂O, and then ABP dropped down to 70/40 mmHg. Immediately, we administered 8 mg dopamine bolus and maintained at 5 µg/kg/min to improve cardiac contractility. Patient's ABP rebounded to 110/60 mmHg. Thirty minutes later, ABP went down again, and then no cardiac input was detected. Standard cardiopulmonary resuscitation was initiated with 2 mg epinephrine intravenously right away. The surgery was suspended.

Patient was transferred to intensive care unit promptly. His heart rate stayed at 120 beats/min, and BP was 95/56mmHg with epinephrine and norepinephrine infusion. SpO₂ was 95%. Because of persistent hypotension of this patient, up to a liter of intravenous fluid was administered. Correction of metabolic acidosis and blood glucose rise was also performed according to the abnormal results of blood gas analysis. We injected 150 ml of 5% sodium bicarbonate intravenously, and 8U insulin subcutaneously. Patient was stabilized with mechanical ventilation and vasopressor infusion. Bedside ECG showed a sinus rhythm, unsustained atrial tachycardia, acute right ventricle myocardial infarction, acute inferior wall ischemia, and atrioventricular conduction delay. Laboratory results were as follows: troponin I, 0.655ng/mL; total creatinine kinase (CK), 672.7U/L; CK-MB, 54.9U/L; lactic dehydrogenase, 388U/L. The patient was diagnosed with left femoral neck fracture, acute right ventricle myocardial infarction, and cardiopulmonary resuscitation syndrome. The patient stayed in a deep coma with intubation in the following 4 days, depending on persistent infusion of epinephrine. Finally, the patient's family gave up the treatment, and the patient was discharged automatically.

DISCUSSION

Right ventricular myocardial infarction (RVMI) usually does not exist in isolation.⁹ The incidence of an isolated RVMI is less than 3%, which may be illuminated by the following characteristics: lower oxygen requirements of the right ventricular due to its smaller muscle mass and workload than the left ventricular; increased blood flow during diastole and systole; more extensive collateralization of the right ventricular, primarily from the left coronary system; and easy diffusion of oxygen. However, RVMI associated with ischemia of inferior wall has a higher mortality.^{10,11} We describe an elderly patient who suffered from RVMI during hip fracture surgery.

The management of geriatric patients is multidisciplinary. It requires careful medical evaluation. Cardiovas-

cular risk factors have to be well evaluated preoperatively. Perioperative management, postoperative care and ultimately rehabilitation have to be planned under multidisciplinary collaboration. Surgeons and anesthetists should work collaboratively and devote themselves to eliminate the incidence of perioperative complications. There is no general consensus on the appropriate anesthesia mode for hip surgery in elderly patients. Some evidence suggested that regional anesthesia was associated with fewer cerebrovascular accidents,¹² lower early mortality of acute postoperative cognitive dysfunction, and lower incidence of fatal pulmonary embolism, compared to general anesthesia. General anesthesia is associated with reduced surgery time and a lower incidence of hypotension.¹³ It should be kept in mind that elderly patients benefit from early mobilization, rehabilitation and restoration of their independence. Nevertheless, anesthesia types may only play a secondary role in mobility, rehabilitation and discharge destination. In addition, patient's choice sometimes could be a vital factor. In our case, we chose general anesthesia because the patient was reluctant to accept regional anesthesia.

The standard practice of anesthesia for geriatrics during surgery is to control any slight cardiovascular changes and to use low or minimal myocardial depressants. However, unlike young patients, physiological characteristics of geriatrics include limited reserve and significant interindividual variability. Elderly patients usually have less ability to respond to hypovolemia, hypotension, tachycardia or hypoxia with an increase in heart rate, which are detrimental for coronary oxygenation. If there is evidence of low cardiac output with absence of pulmonary edema, cardiac output is dependent on adequate filling and emptying of the left ventricle (LV). In the presence of an RVMI, the impaired right ventricle (RV) function causes a decrease of RV stroke volume, which will subsequently lead to a fall of LV filling. Thus, any medications that decrease the preload should be avoided. In our case, anesthetics were applied gradually in a very low dose in accordance with patient's response. No abrupt increase of CVP occurred until the surgeons were about to fix the prosthesis at 40 minutes after the beginning of the surgery. To sum up, the surgical procedure, patient's position change and preoperative condition may all play a pivotal role in the cardiac arrest in this patient. In addition, the diagnosis of RVMI should occur to us in the presence of sudden hypotension or cardiogenic shock without signs of LV failure or 1mm ST segment elevation in the V4R lead. Specific treatment, including fluid loading and vasopressors, should be administered immediately. Right-sided precordial leads should also be used in all patients presenting with an acute myocardial infarction.

Differential diagnosis between RVMI and pulmonary

embolism (PE) is often difficult due to similar clinical features, unspecific electrocardiographic changes and unspecific biological markers. It is very important to know the risk factors and the associated comorbidities. In most cases, the clinical manifestation is the key point for determining the underlying pathology. The electrocardiography (ECG) is helpful to differentiate RVMI from PE, but is only of specific significance in 30% to 40% of cases. The ST elevation over 0.5mm in V4R lead is highly sensitive for RVMI. However, ECG changes in PE are frequently non-specific and transient, and they are less prominent when hemodynamic status is corrected. In addition, cardiac markers for necrosis, such as CK, CK-MB and troponins, can help in diagnosis. One of the most important tests in the diagnosis of PE is D-dimer. The elevated level of D-dimer has a high sensitivity of 96%, while a normal D-dimer level suggests a low probability of PE. Chest X-ray, echocardiography, computer tomography (CT) are also useful.¹⁴

Safety in the management of anesthesia for the elderly is challenging. Selecting an appropriate anesthesia type for elderly patients with hip fracture is always a controversial issue. There is still no general consensus on the anesthesia mode. Perioperative evaluation is important to find out the potential risks, and to optimize the preoperative preparation for preventing perioperative cardiac arrest. Our case suggests that diminished cardiac reserve in elderly patients may manifest as exaggerated drop of blood pressure and subsequent developing to RVMI during surgery. Anesthesiologists play a pivotal role in the multidisciplinary management of geriatric patients in perioperative setting. With continuous development of geriatric specific perioperative outcomes, the anesthesiologists have been delivering optimal care using their knowledge of geriatric physiology with the evidence-based therapeutic strategy in chronic medical conditions.

Conflict of Interest Statement

The authors have no conflicts of interest to disclose.

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