Femoral fractures are common and lethal among elderly patients. The elderly suffer more perioperative risks because of their complicated medical conditions and poor physical reserves. During cemented arthroplasty surgery in the elderly, unstable hemodynamic changes are frequently noted when the cement and prosthesis are inserted. Transesophageal echocardiography (TEE) allows rapid perioperative diagnosis and management of hemodynamic changes. We report an elderly patient with paroxysmal atrial fibrillation, in whom a huge serpentine embolus was noted by TEE. Although cardiovascular collapse was encountered during cemented hip arthroplasty surgery, the patient was successfully resuscitated and the related perioperative risk was managed by TEE application. [International Journal of Gerontology 2008; 2(3): 115–119]

Key Words: atrial fibrillation, cardiopulmonary resuscitation, cemented arthroplasty surgery, elderly, transesophageal echocardiography
Because she refused to accept regional anesthesia, we arranged general anesthesia under fentanyl (2 μg/kg), propofol (2 mg/kg) and rocuronium (0.3 mg/kg). The patient’s vital signs were stable after induction. Intra-operative monitoring included pulse oximetry, electrocardiography, noninvasive blood pressure (NIBP), body temperature, and end-tidal carbon dioxide tension (ETCO₂).

Her heart rate and blood pressure suddenly dropped (NIBP, 70/30 mmHg; heart rate, 47/min with a regular heart beat) after placement of a cement-restrictor. Decreased oxygen saturation as measured by pulse oximetry (SpO₂) and ETCO₂ were also noted (SpO₂, 70%; ETCO₂, 14 mmHg). Pure oxygen, positive end-expiratory pressure, and colloid transfusion were employed to correct the patient’s hypoxemic and hypotensive condition.

Her heart rate remained reduced at 10 beats/min even after atropine 1 mg was given intravenously. The operation was ceased and cardiopulmonary resuscitation (CPR) was immediately initiated. The patient regained acceptable vital signs after 15 minutes with external cardiac massage, intravenous fluid resuscitation and appropriate medical treatment, including several administrations of epinephrine, sodium bicarbonate and calcium gluconate.

The patient’s blood pressure and heart rate fell again after 5 minutes. TEE was arranged for cardiac evaluation. Surprisingly, a large serpentine embolus of about 4.5 cm in length was noted in the right atrium (Figure 1). The embolus was rotating in the right atrium and its shape was changing while it floated. Dilatation of the right atrium and right ventricle, diffuse hypokinesis of the right ventricle, and a relatively small size of the left ventricle were also noted. An attempt to aspirate the embolus via the central line was unsuccessful. The embolus disappeared suddenly by itself 20 minutes later when a second TEE survey was performed, without further significant hemodynamic deterioration (Figure 2). The surgery finished soon after CPR, and the patient was transferred to the ICU.

The inotropic agents used to maintain her vital signs were dopamine 10 μg/kg/min and norepinephrine 1.3 μg/kg/min. When she arrived at the ICU after 1 hour, profound hypotension was noted even with high-dose vasoactive agent usage. Emergency embolectomy was suggested by the cardiovascular surgeon but the family refused. They accepted the alternative choice of setting up venoarterial ECMO. The patient was weaned from ECMO after 96 hours and the inotropic agents were gradually decreased. After intensive fluid transfusion, respiratory support management and infection control, she was successfully extubated 10 days later. Bedside transthoracic echocardiography (TTE) revealed mild dilatation of the right atrium and no residual thrombus. She was discharged 1 month later.

Figure 1. (A, B) A midesophageal transesophageal echocardiography view shows a large serpentine embolus in the right atrium. The arrows indicate the thrombi. RA = right atrium; RV = right ventricle.

Figure 2. The embolus remained in the RV for 20 minutes and then disappeared suddenly. RA = right atrium; RV = right ventricle.
Discussion

The etiologies of sudden cardiovascular collapse during femoral neck fracture surgery in the elderly include perioperative myocardial infarction, anaphylactic reaction, anesthetic overdose, and massive pulmonary embolism. For optimal management of hemodynamically unstable patients, timely establishment of a definitive diagnosis and prompt treatment are necessary. Right heart mobile emboli during femoral neck fracture surgery are usually strongly suspected, but represent an unusual echocardiographic finding. This finding portends a poor prognosis with death due to pulmonary embolism.

Massive pulmonary embolism is defined as pulmonary embolism with either hemodynamic collapse or an occlusion exceeding 50% of the pulmonary artery cross-sectional area. In cemented arthroplasty surgery, unstable hemodynamic situations occur in 30–60% of patients when the cement and prosthesis are inserted. A review of several studies revealed that the intraoperative cardiac arrest rate ranged from 0.6% to 10%, with a mortality rate of 0.02–0.5%.

Pushing fat into the disrupted vessel during reaming is thought to be a significant reason for the compromised cardiopulmonary function, and the bone marrow pressure can be increased from 30–50 to 600 mmHg. Hayakawa et al. reported that snow flurries were detected in both cemented and cementless procedures under TEE management during reaming. Koessler et al. reported that positive TEE image findings in 93.34% patients, who accepted intramedullary stem insertion, indicated embolic masses with diameters as large as 5 mm. Such emboli can lodge in the vessel-rich area and create tissue ischemia, inflammation, and platelet aggregation.

Despite the high incidence rate of embolism formation, the incidences of clinical fat embolism symptom development were 0.5–2% in patients with a single long-bone fracture and 5–10% in patients with multiple long-bone fractures. Clinically, the classic triads of fat embolism are respiratory changes, neurologic abnormalities, and petechial rash, but these are difficult to survey in anesthetized patients.

A transient embolus in the right atrium is a rare finding, and means that the embolus is not attached to an intracardiac structure. When a transient embolus is identified, a pulmonary embolism or an intracardiac shunt must be considered. The estimated mortality rate of a transient embolus exceeds 45%. In our case, no intracardiac communication was detected in our TEE findings.

TEE or TTE is helpful for confirming the diagnosis in cases with severe hemodynamic instability. Konstantinov et al. reported that three of eight patients suffered from pulmonary embolism and confirmed the diagnosis by TTE. However, TEE is more feasible for intraoperative monitoring under general anesthesia or in the peri-CPR period than TTE because the image presentation is less restricted by the position of the patient. TEE can also provide better quality images than TTE when surveying the pulmonary artery. However, there are still no guidelines for routine TEE monitoring during operations because of its high cost, the expertise required, and the fact that patients may accept the operation under regional anesthesia.

The optimal treatment for right heart transient thromboemboli is still unclear owing to a lack of prospective randomized trials. Therapeutic alternatives for pulmonary embolism include systemic heparinization, systemic or local thrombolysis, and surgical removal. Although each therapy has its own risks, surgical embolectomy requires major cardiac surgery and the use of cardiopulmonary bypass, and anticoagulants or thrombolysis may cause bleeding complications or thrombus fragmentation resulting in pulmonary or systemic ischemic events. Although surgery offers a more definitive therapy and closure of a right-to-left heart communication if present, the ease and rapidity of administration may make anticoagulation or thrombolysis a reasonable option in some patients. However, anticoagulation only prevents clot propagation and does nothing to address the existing clot. The age and bulk of the thrombus may make some of these clots resistant to thrombolysis. Patients who had been treated with anticoagulants or thrombolysis among surgical patients exhibited the greatest risk of bleeding. Anticoagulation or thrombolysis was contraindicated for our patient because of the high risk of active major wound bleeding. Treatment of acute pulmonary embolism includes hemodynamic support with cautious fluid transfusion, and administration of vasoactive and anticoagulation agents. Fluid challenge is controversial and even harmful, and should not exceed 500 mL.

In our case, a serpentine embolus was found with unstable hemodynamics. We tried central venous...
catheter suction but in vain. Finally, the huge embolus disappeared within 20 minutes without anticoagulation or thrombolytic therapy after CPR. No intracardiac shunting, including ventricular or atrial septum defects, was noted under TEE detection. The fragment may migrate from the right atrium into the pulmonary artery and become partially impacted. The vital signs did not deteriorate further, but TEE revealed persistent right ventricle dilatation after the embolus disappeared (Figure 2). This may be caused by high pulmonary hypertension. We presumed that the original embolus existed before the cement-restrictor was placed (because of the past history of paroxysmal atrial fibrillation) and became larger with cement particle or bone dust aggregation after aiming of the cement-restrictor. Cardiac massage was performed when the vital signs deteriorated. The structure of the serpentine embolus may have been damaged and become fragmented into smaller pieces after the cardiac massage. The fragments traveled from the right atrium to the pulmonary artery and caused partial occlusion of the pulmonary artery to such an extent that the vital signs were not aggravated further. Hayakawa et al. aspirated a blood sample from the right atrium when a snow flurry was detected by TEE during total hip surgery and found that the particles did not originate from the cement but from body tissues.

The mortality of patients with pulmonary embolism is quite high. Stulz et al. calculated that 50% of such patients die within 30 minutes, 70% die within 1 hour and more than 85% die within 6 hours. Emboli that float freely in the heart are related to massive pulmonary embolism and reach high mortality rates of about 45%. Good outcomes in patients with pneumonia and adult respiratory distress syndrome supported by ECMO were reported, but therapeutic strategies for pulmonary embolism using ECMO have not been well described. An acceptable survival rate (57%) in cardiogenic shock caused by pulmonary embolism was documented. Pulmonary reperfusion injury may occur after embolysis, and this may boost right heart failure and leave patients requiring prolonged ECMO support. In our case, ECMO was weaned at 96 hours after set up. Otherwise, heparin-bound ECMO circuits require minimal anticoagulation to prevent hemorrhagic complications.

The indications for emergency embolectomy include patients with acute massive pulmonary embolism, patients with contraindications for thrombolytic treatment, and patients who lack response to resuscitative medication. Emergency embolectomy provides good resuscitation in cardiogenic shock patients, but high operative mortality rates are also reported (20–50%).

In conclusion, TTE or TEE examination is valuable during cemented arthroplasty surgery, especially when unstable hemodynamic statuses are encountered, in order to make a rapid diagnosis and provide immediate treatment. Efforts such as anticoagulation agent administration, thrombolytic therapy or inferior vena cava filter insertion should be arranged to prevent secondary embolism formation, as long as there are no contraindications. ECMO may be one of the choices for further circulation support in pulmonary embolism patients with severe hemodynamic collapse. Although therapeutic strategies using ECMO have not been well described for pulmonary embolism, it improves end-organ perfusion in patients with cardiovascular collapse.

References


