Perioperative mortality secondary to a pulmonary embolism during a surgical implantation of the Endo-Exo-Prosthesis: a case report

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Abstract

We report on a 53-year-old female patient who suffered a perioperative death secondary to a pulmonary embolism (PE) during an implantation of Endo-Exo-Prosthesis. This is a retrospective review of medical case for a patient who had a previous above-the-knee amputation secondary to a failed previous arthroplasty surgery. Our planned surgery was a stage 1 implantation of an Endo-Exo-Prosthesis, and it was performed under general anaesthesia. After 25 min from starting the surgical procedure, the patient sustained a cardiac arrest, and despite an active cardiopulmonary resuscitation for 50 min, the patient did not recover, the ventilator machine was stopped later on, and the patient was declared deceased at that stage. Fatal intraoperative PE is a rare but significant complication during orthopaedic procedures. There are few reports of similar events but include mainly trauma patients with fractured neck of femur. Endo-Exo-Prosthesis is a relatively newly evolved procedure in a unique group of patients. To our knowledge, this is the first case report of such complication during Endo-Exo-Prosthesis implantation. Patient and surgeon should be aware of it, and additional preventive measures like preoperative scoring systems and in special cases using inferior vena cava filter should be considered in patients with high risk of developing venous thromboembolism.

Keywords Osseointegration; Transcutaneous Osseointegrated prosthetic systems (TOPSs); Pulmonary embolism; Amputation

Introduction

Transcutaneous osseointegrated prosthetic systems (TOPSs) have been used as an alternative strategy to the external artificial limbs for patients with limb amputation.1 This technique is commonly performed as a two-stage surgical procedure in which the implant is surgically impacted in the medullary canal of the femur and extended outwards through the skin.1,2 The exo-prosthetic component can be connected to the intramedullary shaft, which passes throughout the skin.2 The technique provides a superior functional outcome and patients satisfaction than does the traditional use of external artificial limb3,4 (Figure 1). Most of the reported complications associated with this technique were related to soft tissue irritation and implant loosening. Hereby, we are reporting a case of perioperative death secondary to a pulmonary embolism (PE) during an implantation of Endo-Exo-Prosthesis.

Case report

This 53-year-old female patient was referred to our tertiary referral centre for consideration of using TOPS implant for her. She has an above-the-knee amputation, which was performed as a result of failed multiple arthroplasty operations. She was initially rehabilitated using an external artificial limb...
but failed to register any progress with it. Her past medical history also includes Obesity Grade III according to the World Health Organization (body mass index 43.6) and a deep venous thrombosis (DVT) of her left arm a few years ago with unknown underlying cause.

The surgical procedure was performed according to the usual two-stage protocol. The first step procedure was performed in a supine position under general anaesthesia with endotracheal intubation. After approximately 25 minutes from starting the surgical procedure and during the last reaming step, a sudden end-tidal CO2 drop occurred, accompanied by a cardiac arrest; the operation was immediately aborted, and cardiopulmonary resuscitation started. The parameters are shown in Figure 2. The resuscitation was performed for 50 min with ventricular fibrillation and amiodarone as per our local resuscitation guidelines. The relevant laboratory values are shown in Table 1. The cardiac echocardiography still showed no cardiac activity. After a multidisciplinary discussion, an arteriovenous extracorporeal membrane oxygenation device was implanted and followed by an urgent computed tomography scan of the head and chest (Figure 3). The diagnosis of PE was confirmed to be associated with hypoxic brain damage. The patient was declared dead after stopping the ventilator machine at the intensive care unit.

**Discussion**

Various predisposing factors play a role in the development of venous thromboembolism (VTE; Tables 2 and 3). One possibility in our case is that the PE could have occurred as a result of undiagnosed existing DVT of the deep pelvic veins, as the patient had been immobilized in a wheelchair for a few years. However, we do not have preoperative Doppler ultrasound or magnetic resonance (MR) imaging of the pelvis prior to surgery, and the patient did not undergo post-mortem study. Therefore, it is difficult to confirm this hypothesis. The other potential cause is that the patient may have had an undiagnosed coagulopathy disorder, as she had previous
upper limb DVT, which is a relatively uncommon incident in a healthy individual.

It is also important to notice that the occurrence of minor PE during surgery is not always obvious. The entire process is influenced by anaesthesia and surgery. Possible clinical symptoms such as dyspnoea, haemoptysis, or chest pain are not visible. Therefore, we do not know the percentage of perioperative non-fatal PE, but its occurrence may be more common than we are aware of.

To minimize the risk of PE during surgery, Donaldson et al. described five critical surgical steps for the implantation during a total arthroplasty. These include cementation

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**Table 1** Predisposing factors for the emergence of venous thromboembolism

| Strong risk factors (odds ratio > 10)                                                                 |
|---------------------------------------------------------------------------------|
| Fracture of the lower extremities                                               |
| Hospitalization for heart failure or atrial fibrillation/flutter (in the past 3 months) |
| Hip or knee joint replacement                                                   |
| Severe trauma                                                                   |
| Myocardial infarction (in the past 3 months), previous venous thromboembolism, spinal cord injury |

| Moderate risk factors (odds ratio = 2–9)                                           |
|---------------------------------------------------------------------------------|
| Arthroscopic knee surgery, autoimmune disease, blood transfusion               |
| Central vein catheter, chemotherapy                                              |
| Heart or lung failure                                                           |
| Erythropoiesis-stimulating substances                                           |
| Hormone replacement therapy (depending on composition)                          |
| In vitro fertilization                                                          |
| Infection (especially pneumonia, urinary tract infection, HIV infection)       |
| Chronic inflammatory bowel disease                                              |
| Cancer (highest risk for metastasis)                                            |
| Oral contraceptives                                                             |
| Stroke with paralysis                                                           |
| Puerperium                                                                      |
| Superficial venous thrombosis                                                   |
| Thrombophilia                                                                   |

| Low risk factors (odds ratio < 2)                                                 |
|---------------------------------------------------------------------------------|
| Bed rest > 3 days                                                               |
| Diabetes mellitus                                                              |
| High blood pressure                                                            |
| Immobility due to long periods of sitting (e.g. long car or air travel)         |
| Higher age                                                                      |
| Laparoscopic surgery (e.g. cholecystectomy), obesity                           |
| Pregnancy                                                                      |
| Varicose veins                                                                  |

**Table 3** Wells score to assess an existing pulmonary embolism

| Wells score                                                                 | Points |
|------------------------------------------------------------------------------|--------|
| Clinical signs and symptoms of DVT                                           | 1.5    |
| Heart rate greater than 100/min                                              | 1.5    |
| Surgery or immobilization in the previous 4 weeks                            | 1      |
| Haemoptysis                                                                  | 1      |
| Malignancy (on treatment, treated in the last 6 months, or palliative)       | 1      |
| Previous DVT/PE                                                              | 3      |
| Alternative diagnosis is less likely than PE                                 | 3      |
| Clinical likelihood for PE                                                    |        |
| Three-level score                                                            |        |
| Low                                                                           | 0–1    |
| Middle                                                                        | 2–6    |
| High                                                                          | ≥7     |
| Two-level score                                                               |        |
| PE unlikely                                                                   | 0–4    |
| PE likely                                                                     | >5     |

**Figure 3** (A, B) Computed tomography of the thorax with contrast medium imaging of the central thrombus in the axial layer, from cranial to caudal.

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**Table 2** Representation of the intraoperative relevant laboratory parameters

| Laboratory parameters | Time/date | Time/date | Time/date | Time/date/ECMO | Time/date |
|-----------------------|-----------|-----------|-----------|-----------------|-----------|
| pH                    | 09:05     | 09:16     | 09:37     | 09:47           | 10:09     |
| pO₂, mmHg             | 7.46      | 7.37      | 7.18      | 7.05            | 7.24      |
| pCO₂, mmHg            | 132       | 157       | 82        | 397             | 467       |
| Lactate, mmol/L       | 26        | 31        | 49        | 65              | 39        |
| Base excess, mmol/L.  | 3.2       | 6.3       | 11.6      | 12.3            | 10.8      |

ECMO, extracorporeal membrane oxygenation.

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of the cavity or shaft, insertion of the prosthesis into the bone, and reduction of the joint and reaming the bone tube, like in our case.\textsuperscript{10,11}

Venous thromboembolism events are a serious and potentially fatal complication that should be avoided by sufficient preoperative, perioperative, and post-operative prophylaxis. Therefore, we recommend that all patients undergoing the Endo-Exo-Prosthesis surgery should be assessed using a preoperative questionnaire to categorize the risk of VTE (Table 2).\textsuperscript{5–8} Moreover, if their risk profile is increased, assessment should be followed by a preoperative Doppler ultrasound of the lower limbs, MR imaging of the pelvis, and perioperative antithrombotic prophylaxis according to the guidelines of the German Association of the Scientific Medical Societies of Thromboembolism. Owing to its associated potential complications, the inferior vena cava filter may only be considered in special circumstances.\textsuperscript{12–15}

**Conflict of interest**

The authors declare no conflict of interest.

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