Fat embolism syndrome is the presence of a fatty embolus in the circulatory system that can manifest itself in multiple ways, ranging from asymptomatic presentation to respiratory failure, neurocognitive deficits, and death. It is a relatively common complication after procedures or conditions such as orthopaedic surgery, severe burns, liver injury, closed-chest cardiac massage, and liposuction. This pathology is relatively common in the field of orthopaedics, especially in long bone fractures and procedures such as total hip replacements. It is typically an exclusion diagnosis, and the management is supportive care. In this report, we present a case of a 63-year-old patient who, during a cemented total knee replacement, presented with fat embolism syndrome with neurological and pulmonary manifestations, and subsequently made a complete recovery at discharge.

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The literature shows that 1%-5% of patients suffering from pelvic trauma, long bone fractures, and some orthopaedic procedures can present with FES [1]. In this group of patients, 75% will have respiratory symptoms as the initial presenting sign, 86% will present neurological alterations, and only 20%-50% will present with a cutaneous petechial rash [10]. The symptoms may take up to 24-72 hours to develop following the injury or intervention [2,10].

In the last 20 years, at least 4 clinical cases have described the association between FES and unilateral TKA [11-14]. Two of the cases developed symptoms intraoperatively and the other 2 within 6-36 hours postoperatively, respectively. Two of the patients suffered cardiac arrest and 1 of them passed away. The rest of the patients made a complete recovery.

In this report, we present a case of a 63-year-old patient who, during a left TKA, presented with symptoms of FES intraoperatively including hypoxemia and decreased PO2 saturation level. Clinically, she developed aphasia, dyspnea, and facial paralysis as the condition evolved. Following supportive care, she eventually made a complete recovery at discharge.

No author associated with this paper has disclosed any potential or pertinent conflicts which may be perceived to have impending conflict with this work. For full disclosure statements refer to https://doi.org/10.1016/j.artd.2019.09.004.

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https://doi.org/10.1016/j.artd.2019.09.004
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Her usual medications included bupropion, venlafaxine, prednisone, hormone replacement therapy, valsartan, calcium plus vitamin D, and levothyroxine. She had no known drug allergies.

The patient visited our orthopaedic clinic with a history of long-standing left knee pain, and a prior open surgery for fixation of a femoral condyle fracture 20 years ago.

Her physical examination revealed a valgus alignment of approximately 20°, with medial-lateral instability, moderate joint effusion, tricompartmental pain, and preserved range of motion from full extension to 130° of flexion.

Her left knee radiographs showed tricompartmental osteoarthritis more severe in the lateral compartment, with valgus alignment (Fig. 1a). The long leg alignment films showed a mechanical valgus misalignment of 15°.

Therefore, we recommended proceeding with a cemented left TKA with a semi-constrained implant and revision stems for both the tibia and femur (Fig. 1b).

The surgery started with a standard longitudinal anterior approach. The capsule was entered through a medial parapatellar incision. The tibial preparation was done using sequential intramedullary reaming until cortical chatter was achieved (17 mm). A clean-up cut to produce a resected surface with a neutral slope was performed with the oscillating saw. No offset and augments were used. The femoral preparation was done using an intramedullary guide with sequential reaming until cortical chatter was achieved (18 mm). The femoral cuts were performed according to the femoral resection guides. No femoral offset or augmentations were used. After stability, alignment and trial implants were checked; cemented definitive implants were impacted into the prepared surfaces. The tourniquet was deflated after a total ischemia time of 120 minutes, with minimal bleeding.

After cementation, and at the moment that the tourniquet was deflated, the patient had an episode of oxygen desaturation down to 80% and EtCO2 decrease, which promptly and spontaneously recovered, but alerted the anesthesia staff.

During the immediate post-operative recovery phase, right facial paralysis, dysarthria, and vision loss were present. The patient was evaluated immediately by a neurologist, who specifically noted aphasia, right hemianopsia, complete right hemiplegia, right hemiparesis of brachial predominance, without facial paralysis or meningeal signs. Deep tendon reflexes were present, and National Institutes of Health stroke score was 11 (moderate).

Complete imaging studies were performed with a head computed tomography (CT), brain magnetic resonance imaging (MRI) with diffusion, and a CT chest angiogram. The head CT did not show any lesions; however, an MRI with diffusion showed hyperintense images in T2 (starry sky pattern), suggestive of hyperacute ischemia (Fig. 2). The CT chest angiogram showed embolic defects in multiple branches at the segmental and subsegmental bilateral pulmonary arteries, with characteristics suggesting a fat embolism (FE) (Fig. 3).

The patient was transferred to the intensive care unit (ICU) for close monitoring and support. Given the contraindication of performing therapeutic anticoagulant treatment due to recent surgery and the risk of hemorrhagic transformation of brain lesions, an inferior vena cava filter was placed without incidents in an
infrarenal position. In addition, a nasogastric tube was placed to manage any possible swallowing disorder. Empiric treatment with intravenous (IV) corticosteroids was initiated, using methylprednisolone 6 mg/kg divided into 6 doses to be administered in 48 hours (40 mg every 8 hours IV for 2 days).

On her second post-operative day, she presented a clear regression of the neurological symptoms, accomplished activation, and movement of all her limbs against gravity without problems. Her O2 requirements decreased drastically. She recovered language almost completely with some minor difficulties with tone, and responded satisfactorily to motor, neurological, and respiratory physical therapy. The patient was maintained with general hemodynamic support in the ICU for 3 days and then transferred to intermediate care. She was discharged 10 days after surgery, without any ongoing sequelae.

At the time of the current report, the patient has been followed for more than 2 years, without any additional complication secondary to her knee replacement, and an overall excellent functional and clinical outcome.

Discussion

FE is the presence of fat droplets in the circulatory system, which may or may not present symptoms. Between 3%-5% of cases develop FES, which consists of damage and dysfunction of certain organs due to FE, usually occurring within 12-72 hours after the intervention or injury [10].

FES is usually observed in cases of long bone fractures (0.9%-2.2%) [15], but it has also been described in certain orthopaedic procedures, with simultaneous bilateral knee arthroplasty being one of the most frequent (0.17%) [16]. The presence of confusion in post-operative patients following unilateral knee arthroplasty is 4 times lower than in those treated simultaneously [17]; however, the index of suspicion in these patients must be high.

It is a diagnosis of exclusion based on a myriad of clinical symptoms. Several organs may be affected; however, the 3 major clinical findings include respiratory dysfunction, neurological alterations, and skin rash of variable extension. Diagnosis is made by clinical criteria proposed by Gurd and Wilson [7], requiring 2 major criteria or 1 major criterion plus 4 minor criteria to make the diagnosis (Table 1).

The use of advanced imaging and laboratory tests is complementary since they can help guide our differential diagnosis and rule out other entities. In addition, they may aid in patient prognosis, but they are not specific for this FES pathology [1,3,18].

Brain MRI is very useful when faced with diagnostic uncertainty due to its greater sensitivity, especially after a negative head CT, as we observed in our case [8,19].

Figure 2. Brain magnetic resonance image: (a) sequence of diffusion where a hyperintensity focus (starry sky pattern) of the left periventricular white matter is observed (inside the white circle). (b) Apparent diffusion coefficient map with presence of negative values, consistent with a focus of restriction, which can be observed in the context of a hyperacute stroke.

Figure 3. CT chest angiogram with pulmonary protocol, where adequate opacification of the pulmonary arteries and its branches is observed. Central filling defects are visualized in bilateral segmental and subsegmental branches consistent with acute pulmonary thromboembolism: (a) axial cut and (b) coronal cut.
When FES is encountered, prevention, early detection, and appropriate management are crucial. The risk is greater in adults, obese or polytraumatized patients [5,6]. Adili et al [20], in a comparative cohort study, observed a higher incidence of FES in patients with risk factors undergoing simultaneous bilateral knee arthroplasty vs unilateral arthroplasty, especially when a tourniquet was utilized.

Modifications of surgical techniques such as cementless arthroplasties or the use of computerized assisted navigation have not shown to have a lower incidence of FES [21]. However, irrigation of the femoral canal and aspiration of the bone marrow contents have shown satisfactory results, decreasing the incidence of FES [22].

We did not find any studies that address the relevance of the femoral canal reaming on the incidence of FES for total knee replacement procedures, which could be a factor to consider in our specific case report.

The probability of facing FES after a revision arthroplasty is actually lower because the fatty tissue of the medullary canal was removed in the first surgery. It is believed that the multiple impacts and attempts to remove the prosthesis may be the cause of this complication in revision scenarios [23].

Regarding the treatment, mainly supportive measures are required. Maintenance of arterial oxygenation within normal ranges and the adequate control of fluid resuscitation and avoiding fluid overload are fundamental for the prevention of shock, which can exacerbate lung and brain damage caused by FES [8,9].

There are no comparative studies supporting the use of corticosteroids, while some studies note its ineffectiveness [13]. In our case, IV methylprednisolone was implemented empirically for 2 days upon admission to the ICU, which may or may not have been beneficial.

Finally, the use of heparin is not only considered ineffective, but it can worsen the clinical picture in the setting of FES by increasing the risk of hemorrhages and fatty acids in the circulatory system [24,25]. In our case, the relative contraindication of anticoagulant use because of the previous surgery, an inferior vena cava filter was implanted.

Summary

Despite the low incidence of FES in unilateral knee arthroplasty, one must always consider it and have a high index of suspicion in the presence of neurological and/or respiratory alterations following surgery. Early diagnosis along with supportive measures including close monitoring, hemodynamic control, and adequate rehabilitation is essential. It is crucial to avoid the use of anticoagulant therapy as it can worsen the clinical scenario in a case of FES.

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