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Fat embolism secondary to gluteal biopolymer injection. Case report

Embolia grasa secundaria a inyección de biopolímeros en glúteos. Reporte de caso

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Abstract

Fat embolism secondary to biopolymers is a serious complication of unregulated cosmetic procedures, associated with high morbidity and mortality. This is a case of a 21-year-old female patient with acute respiratory failure and hemoptysis following biopolymer injection in the gluteal region. The diagnosis was confirmed by transbronchial biopsy and pulmonary imaging, which revealed fatty material in the lungs. Treatment included non-invasive mechanical ventilation, anticoagulation, and corticosteroids, leading to a positive clinical outcome. This case highlights the importance of early recognition and timely therapeutic intervention in patients with suspected fat embolism secondary to biopolymers, and contributes to the clinical understanding of its management and outcomes.

Key words:

Fat embolism; Pulmonary embolism; Fat embolism syndrome; Biopolymers; Cosmetic procedures.

Resumen

La embolia grasa secundaria a biopolímeros es una complicación grave de los procedimientos estéticos no regulados, con alta morbilidad y mortalidad. Se presenta el caso de una paciente de 21 años de edad con insuficiencia respiratoria aguda y hemoptisis tras la inyección de biopolímeros en los glúteos. El diagnóstico se confirmó mediante biopsia transbronquial e imágenes pulmonares que evidenciaron material adiposo en los pulmones. El tratamiento incluyó ventilación mecánica no invasiva, anticoagulación y corticosteroides, con lo que se logró una evolución clínica favorable. Este caso resalta la importancia del reconocimiento temprano y del abordaje terapéutico oportuno en pacientes con sospecha de embolia grasa secundaria a biopolímeros, y contribuye al conocimiento clínico sobre su manejo y desenlace.

Palabras clave:

Embolismo graso; Embolismo pulmonar; Síndrome de embolia grasa; Biopolímeros; Procedimientos estéticos.

INTRODUCTION

Biopolymers, including liquid silicone, have been used in medicine since the 1960s for various medical purposes, including aesthetic procedures. However, adverse events have been documented in multiple reports over time, resulting in medical use restrictions and their prohibition in cosmetic procedures in many countries starting in the 1970s. (1,2) Despite these bans, illicit use has persisted, resulting in both local and systemic complications, including silicone migration and the development of fat embolism secondary to illicit use of biopolymers. (3,4) Initial reactions include inflammation, edema, erythema, and granuloma formation, but in more severe stages, migration of particles to deep tissues and embolic phenomena have been identified, among others. (5)

There are several potential theories to explain the pathogenesis of fat, most notably mechanical migration and toxic products-induced vascular damage. (6,7) In the first case, accidental intravascular injection or excessive pressure during administration may allow the passage of fat particles into the circulation, causing pulmonary embolism. In the second case, vascular damage induced by chemical components within biopolymers may trigger the breakdown of triglycerides into free fatty acids, leading to a systemic inflammatory response and capillary obstruction. Cases of massive pulmonary embolism following the injection of substances such as polypropylene have been documented, reinforcing the hypothesis that these particles can enter the venous circulation and reach the lungs, causing respiratory failure and, in some cases, death. (6) Anatomical studies in cadavers have confirmed the presence of large-caliber veins within the deep gluteal region, increasing the risk of embolization when substances are injected into deep planes instead of into the subcutaneous plane. (7) Clinical evaluation and imaging studies, such as magnetic resonance

imaging (MRI) and computed tomography (CT), are critical for early detection and appropriate diagnosis and treatment. (8,9) In this context, this case report provides relevant clinical insights into the manifestations and complications associated with biopolymer use.

CASE PRESENTATION

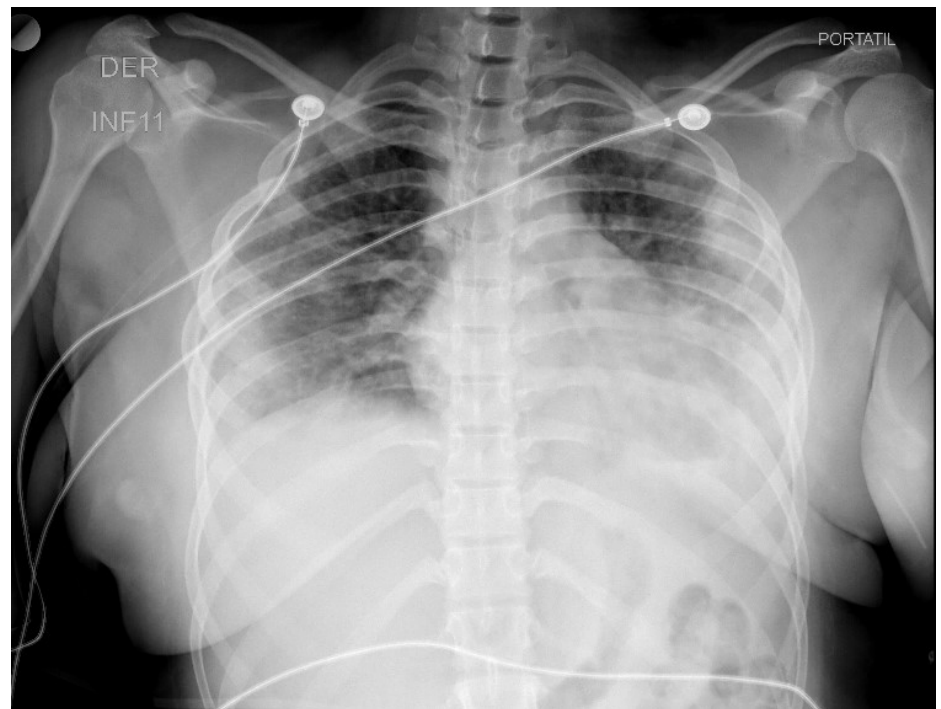
The case refers to a 21-year-old female patient with unremarkable medical history, who presented with a five-day progression of symptoms characterized by cough, progressive dyspnea, occasional episodes of hemoptysis, and fever following biopolymer injection in the gluteal region.

Upon admission to the emergency department, the patient had a heart rate of 126 bpm, blood pressure of 95/60 mmHg, respiratory rate of 30 breaths per

minute, oxygen saturation of 92% with supplemental oxygen at 4 L/min via nasal cannula (FiO₂ 36%), and a temperature of 37.8°C. Physical examination revealed decreased breath sounds in both lung bases without evident signs of localized consolidation. Initial tests included complete blood count, renal function, C-reactive protein, troponin, and electrolytes, all within normal limits, except for but an elevated D-dimer (799 ng/mL, normal limit <500 ng/mL), raising initial suspicion of pulmonary embolism. Chest X-ray revealed a multilobar inflammatory process with bilateral pleural effusion, reinforcing the need for further studies (Figure 1).

Given the suspicion of pulmonary embolism, a pulmonary artery CT angiography was performed, which ruled out this condition. However, bilateral subpleural ground-glass opacities and

Figure 1. Admission chest X-ray.



Portable chest X-ray, AP view: diffuse alveolar opacities with obliteration of the costophrenic angle in both lung bases.

Source: Authors.

segmental consolidations in the lower lobes of both lungs were identified (Figure 2). Initial arterial blood gas analysis showed severe hypoxemia with a pH of 7.45, PaCO₂ of 32 mmHg, PaO₂ of 55 mmHg, bicarbonate of 22 mEq/L, oxygen saturation of 91%, and base excess of -1.8, indicating impaired oxygenation and a compensatory ventilatory response.

Non-invasive BiPAP mode mechanical ventilation (NIMV) was initiated with IPAP of 14 cmH₂O, EPAP of 6 cmH₂O, and FiO₂ of 60%. Six hours later, arterial blood gases showed improved oxygenation with a PaO₂ of 70 mmHg and a decrease in lactate to 2.1 mmol/L. As the patient continued to improve, NIMV settings were adjusted with reduced ventilatory support to IPAP of 12 cmH₂O, EPAP of 5 cmH₂O, and FiO₂ of 40%, achieving normalization of blood gases by the third day, with a PaO₂ of 85 mmHg and complete withdrawal of ventilatory support.

Empirical antibiotic therapy was initiated with ceftriaxone 2 g IV every 24 hours and azithromycin 500 mg IV every 24 hours for 5 days, considering the differential diagnosis of atypical pneumonia due

to fever and pulmonary consolidations on imaging. Methylprednisolone was started at a dose of 1 mg/kg/day IV, based on previous reports suggesting potential benefit in biopolymer-induced inflammatory response and in suspected chemical pneumonitis.

The decision to initiate full anticoagulation with enoxaparin 40 mg (1 mg/kg) SC every 12 hours was based on the elevated D-dimer and the possibility of pulmonary thromboembolism, pending confirmatory studies. Once thromboembolism was ruled out by CT angiography, the possibility of fat embolism secondary to biopolymers was considered, and anticoagulation was maintained at the aforementioned therapeutic dose, given the limited but growing evidence of its usefulness in cases of fat embolism with severe respiratory manifestations.

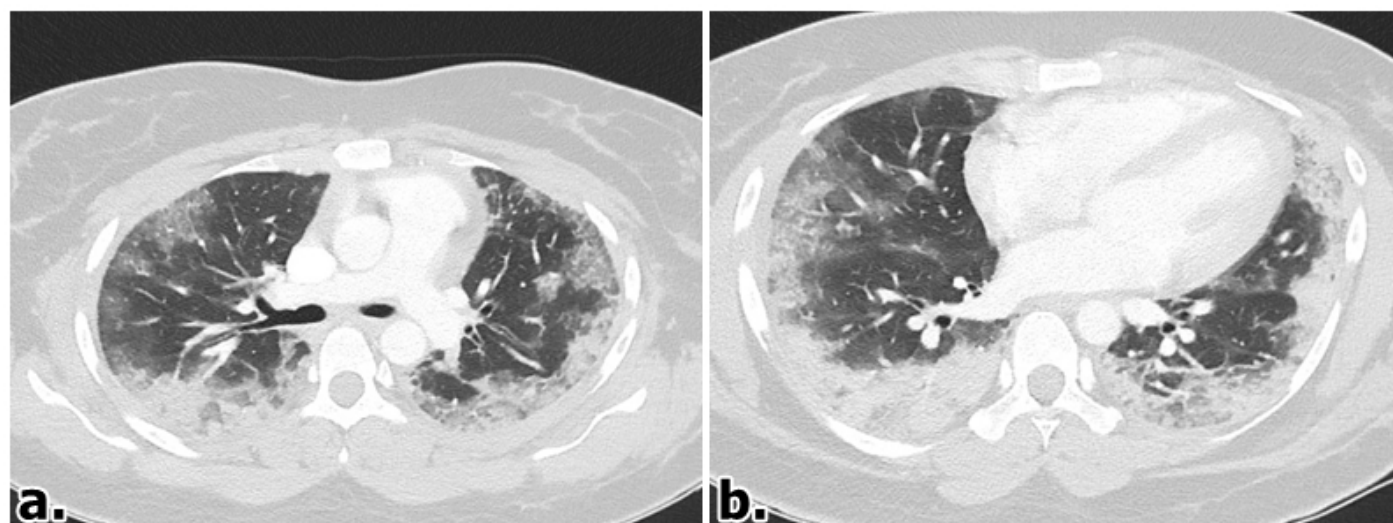
During hospitalization, the patient showed progressive improvement in symptoms and gasometric stability. The transbronchial biopsy performed via fiberoptic bronchoscopy revealed alveolar

reactive changes, interstitial hemorrhage, and vacuolated material likely of adipose origin, confirming the diagnosis of pulmonary fat embolism. A follow-up chest X-ray at 7 days showed decreased alveolar opacities and improved oxygenation (Figure 3), allowing for hospital discharge with outpatient follow-up by the pulmonology service.

DISCUSSION

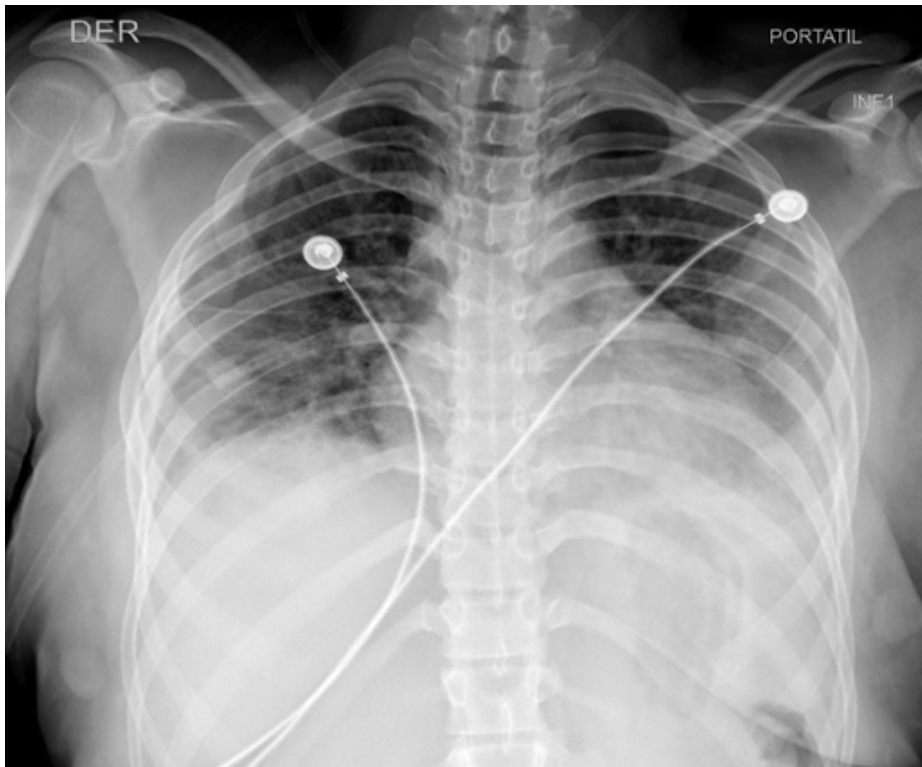
In this case, the pulmonary fat embolism secondary to biopolymers was confirmed by histopathological findings in the transbronchial biopsy, which revealed vacuolated material of adipose origin. However, the possibility of biopolymer migration is a phenomenon widely described in the literature. According to Ortiz-Urbe et al. (5), the dissemination of these substances occurs in up to 80% of patients in advanced stages, underscoring the importance of imaging studies for detection. In their case series, MRI enabled precise identification of exogenous

Figure 2. Pulmonary artery CT angiography.



Lung window (a, b): bilateral diffuse subpleural ground-glass infiltrates and segmental subpleural consolidations predominantly in the lower lobes of both lungs.

Source: Authors.

Figure 3. Follow-up chest X-ray.

Portable chest X-ray, AP view: decreased diffuse alveolar opacities.

Source: Authors.

material and its extent, highlighting its value in diagnosing late biopolymer migration. Nevertheless, in this patient, high-resolution CT was the primary imaging tool, as it allowed for rapid assessment of pulmonary involvement and ruled out pulmonary thromboembolism, which was one of the main initial diagnostic hypotheses. CT provided detailed information on ground-glass infiltrates and pulmonary consolidations, findings later confirmed by transbronchial biopsy.

Although MRI is a highly accurate method for soft tissue assessment and potential identification of biopolymer migration, its use in the context of acute respiratory failure is limited due to restricted availability, longer image acquisition times, and technical difficulties in critically ill patients. CT, by contrast, remains the first-line modality for assessing

severe pulmonary involvement, as it enables rapid and detailed characterization of parenchymal damage and helps exclude other potential etiologies. (10) In this case, CT not only confirmed pulmonary involvement secondary to fat embolism but also guided therapeutic decision-making.

Kim et al. (11) address fat embolism syndrome from its pathophysiological origins. In this context, the authors describe two increasingly accepted theories: mechanical obstruction by fat globules and biochemical damage due to free fatty acid load. This information helped correlate the patient's clinical presentation with severe hypoxemia. The same authors also describe the ground-glass pattern as a classic feature on pulmonary CT. Additionally, the authors report that using high pressure during the injection of substances associated

with biopolymers may increase the risk of fat embolism. (11)

The diagnosis of pulmonary fat embolism is based on a combination of clinical, imaging, and histopathological findings. In this case, the patient met several of Gurd's criteria, including respiratory symptoms such as dyspnea, tachypnea, and bilateral alveolar infiltrates, as well as persistent tachycardia. However, unlike other cases described in the literature, there was no neurological involvement or petechial rash in this patient, highlighting the variability in clinical expression of this condition. Lindeque's criteria, which emphasize gasometric deterioration and increased respiratory effort, were also relevant in this case, as the patient presented with severe hypoxemia (PaO_2 55 mmHg) and marked tachypnea, justifying the initiation of non-invasive ventilation. The absence of neurological and skin symptoms in this patient demonstrates the heterogeneity of fat embolism and underscores the importance of maintaining a high index of diagnostic suspicion, even in atypical cases.

(12) The literature, including the analysis by Mundada et al., has noted that diagnosing fat embolism is a clinical challenge, as it can mimic infectious or neoplastic conditions, particularly in patients with a history of injectable fillers. (13) The identification of vacuolated adipose material in the lung biopsy not only confirmed the etiology of respiratory failure in this patient but was also instrumental for accurate therapeutic guidance and timely management.

In this case, the imaging diagnostic criteria used to identify pulmonary fat embolism were extrapolated from existing literature on fat embolism of other etiologies, such as bone fractures and invasive surgical procedures. Although no specific validated criteria are available for fat embolism secondary to biopolymer injection, the CT findings described by Qi et al., including ground-glass opacities, subpleural consolidations, and centrilobular nodules in a mosaic pattern, were key findings in this patient. (10) Considering

that biopolymer-associated fat embolism is a rare entity with few reported cases, pulmonary imaging plays a fundamental role in the differential diagnosis with other pathologies such as chemical pneumonitis, pulmonary thromboembolism, and infectious pneumonia. In this regard, CT enabled a detailed evaluation of pulmonary involvement, exclusion of other etiologies, and strengthened the suspicion of fat embolism as the main underlying pathogenic mechanism. (10) Despite the high diagnostic value of imaging in this context, transbronchial biopsy was necessary to confirm the diagnosis and rule out other possible complications associated with biopolymers, such as migration of synthetic material and chronic inflammatory response. In cases of post-traumatic fat embolism, histopathological confirmation is not always required, as the clinical and radiological context is often enough to make a diagnosis. (10) However, in this specific case, the lack of well-established diagnostic criteria for biopolymer-associated fat embolism justified performing a lung biopsy, which revealed vacuolated adipose material in the lung tissue, confirming a fat embolism etiology of the clinical presentation.

The findings of Soliman et al. highlight that liquid silicone migration can mimic neoplasms or cause chronic inflammation years after its administration, complicating the differential diagnosis. Although in this case the CT suggested fat embolism, confirmation via transbronchial biopsy ruled out biopolymer migration as the primary cause, emphasizing the importance of a histopathological assessment in these patients. (14)

Furthermore, a comprehensive fat embolism syndrome review by Timon et al. reports a wide variation in the incidence rate - from 0.9% to 19% - in trauma patients, depending on the design of the study. This range reflects the complexity of diagnosis when symptoms may overlap with other clinical conditions. (15) In this particular case, the initial diagnosis of pulmonary embolism underscored the

need for a broad differential diagnosis, while maintaining a high index of clinical suspicion to avoid management delays. The issue of unauthorized procedures such as biopolymer injection has been significantly neglected in the literature. The work by Castro et al. stands out, indicating a high prevalence of complications related to biopolymers in Latin America, which may be associated with the lack of regulation regarding their use. According to their findings, 33.6% of patients were not aware of the particular substance injected, while 28.1% reported having received biopolymers. Given the nature of this problem, such complications may even affect individuals identified as vulnerable, as is likely the case with our patient, who may have undergone a procedure performed by unqualified personnel. (16)

Biopolymer injection-associated pneumonitis is a rarely described entity in the literature, but its pathophysiological mechanisms share similarities with other pulmonary complications induced by exogenous substances, such as silicone embolism syndrome and silicone pneumonitis. Schmid et al. compared silicone embolism syndrome with fat embolism, noting that both share symptoms such as dyspnea, hypoxemia, hemoptysis, and alveolar hemorrhage, which may lead to challenging clinical and imaging differentiation. (17) In this case, the identification of adipose material in the transbronchial biopsy confirmed fat embolism as the main pathogenic mechanism, in contrast to potential biopolymer-induced pneumonitis or a silicone-induced inflammatory response.

Blanco et al. described a case of silicone pneumonitis with diffuse alveolar hemorrhage and acute respiratory distress syndrome (ARDS), managed with corticosteroids and protective ventilation, highlighting the importance of early identification to prevent fatal outcomes. (18) Similarly, Eckle et al. reported a case of acute respiratory failure following silicone injection, in which the differential

diagnosis included chemical pneumonitis and fat embolism. (19) These studies reinforce the need to consider both the direct toxicity of biopolymers and their potential for embolization when evaluating patients with acute respiratory failure after unregulated cosmetic procedures. In this particular case, hypoxemia, ground-glass pulmonary infiltrates, and alveolar hemorrhage guided the diagnosis, and the combination of imaging studies with transbronchial biopsy confirmed the fat embolism etiology, which clearly differentiated it from other pulmonary complications described in the literature.

It should be emphasized that the treatment of fat embolism syndrome relies primarily on supportive care, with a focus on maintaining adequate arterial oxygenation to prevent multiorgan damage. Therefore, it is essential to provide high-flow supplemental oxygen, along with mechanical ventilation cycles and positive end-expiratory pressure in more severe cases. This approach has been shown to significantly improve clinical outcomes and prevent fatal respiratory complications. Other agents used in this context, such as steroids and heparin, have shown limited efficacy, underscoring the need for more effective therapeutic approaches. (20)

Another aspect to consider in this type of pathology is the autoimmune/inflammatory syndrome induced by adjuvants (ASIA), which represents a potential long-term complication in patients exposed to exogenous substances such as biopolymers and silicone. Studies by Alijotas-Reig et al. and Pavlov-Dolijanovic et al. have documented the association between biomedical materials and the development of late-onset autoimmune or inflammatory diseases, highlighting manifestations such as arthralgia, chronic fatigue, Raynaud's phenomenon, and the development of autoantibodies. (21,22) In this particular patient, the history of biopolymer exposure, combined with the initial inflammatory response, justifies long-term follow-up to identify possible manifestations of ASIA.

Since ASIA may develop months or years after exposure, it is essential to conduct periodic follow-ups including clinical, autoimmune, and imaging assessments. Puerta Sarmiento et al. reported a severe case with pulmonary and mediastinal involvement secondary to silicone, in which immunomodulatory treatment was necessary to control the inflammatory response. (23) In this case, although the patient evolved favorably after the acute phase, monitoring was recommended to detect symptoms suggestive of autoimmune dysfunction, such as persistent fatigue, arthralgia, Raynaud's phenomenon, or lung impairment.

The treatment of fat embolism remains controversial, as there are no specific therapeutic strategies with robust evidence to support their systematic use. In general, management consists of ventilatory and hemodynamic support; however, some therapies have been explored with variable results. The use of heparin has been suggested based on its ability to stimulate lipoprotein lipase and facilitate lipid clearance from the circulation; however, its efficacy is not clearly established. Kosova et al. argue that heparin could increase the release of free fatty acids, potentially exacerbating the underlying inflammatory state and worsening lung injury. (24) Likewise, the administration of N-acetylcysteine has been explored for its antioxidant properties and potential to reduce lung damage in experimental models, although its benefit in humans is not well documented. (25)

Moreover, clofibrates, known for their lipid-lowering effects, have been studied in animal models to lower blood lipid concentrations and decreasing the severity of fat embolism. However, previous studies have shown that their therapeutic effect is limited and apparently fail to impact morbidity and mortality of patients with fat embolism. (26) Since these therapeutic options have not shown clear benefits in large clinical trials, the treatment of choice is still ventilatory support and general stabilization measures, with the possibility of considering corticosteroids in certain

cases to modulate the inflammatory response. Further studies are needed to define the role of these strategies in the management of fat embolism, particularly in non-traumatic scenarios such as this case of biopolymer injection.

In the context of Colombia, the limited regulation of aesthetic procedures, coupled with the high prevalence of illicit practices, underscores the urgent need for public policies and educational initiatives aimed at preventing complications related to biopolymer use. In this regard, Decree 545 of 2024, which regulates the commercialization and use of modeling substances in the country, represents a step forward. The implementation of a traceability system may help mitigate the risks associated with the excessive use and administration of these products. (27) However, such implementation must be accompanied by strict controls, effective sanctions, and awareness campaigns to ensure a favorable impact. Additionally, future research should focus on diagnostic and therapeutic strategies allowing for a comprehensive approach to the disease, minimizing its impact on patients and the healthcare system.

CONCLUSION

Fat embolism secondary to biopolymer injection is a devastating complication of illicit cosmetic procedures. This underscores the need to strengthen regulatory frameworks and oversight of these interventions. The case presented illustrates how a comprehensive clinical approach – integrating advanced diagnostic tools and timely therapeutic intervention – can significantly improve outcomes in life-threatening conditions. However, the evidence of insufficient specific diagnostic and therapeutic tools, as well as the knowledge gaps with regards to this pathology, ratifies the current need for more effective alternative approaches.

In a country like Colombia, with a significant high rate of illicit cosmetic procedures, this issue requires not only

a stricter and up-to-date regulatory approach—such as Decree 545 of 2024—but also a call for further research in this field. Specifically, such research efforts should focus on attributable pathophysiological mechanisms, comparable diagnostic criteria, and additional therapeutic options. This approach may ensure improved patient care and address the potential for future local complications.

ETHICAL RESPONSIBILITIES

Protection of humans and animals

The authors declare that the procedures followed complied with the ethical standards of the responsible human experimentation committee and are in accordance with the World Medical Association and the Declaration of Helsinki.

Data confidentiality

This case was published under the authorization of the patient to disclose clinical, paraclinical, and imaging data obtained from her medical record, thereby ensuring the principles of beneficence, non-maleficence, and justice. The principles of confidentiality and privacy were respected, maintaining anonymity.

Right to privacy and informed consent

The authors obtained informed consent from the patients and/or subjects mentioned in the article. This document is in the possession of the corresponding author.

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Author contributions

All authors contributed to the conception, drafting of the initial version, writing of the

final manuscript, review, and approval of the manuscript.

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Conflicts of interest

The authors declare no conflicts of interest.

Presentations

None declared by the authors.

Appreciations

None declared by the authors.

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