Review Article

Liposuction and fat embolism: a literature review

Lipoaspiração e embolia gordurosa: revisão de literatura

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■ **ABSTRACT**

Liposuction surgery is often associated with severe or fatal consequences, causing great repercussions in the medical field, and especially in the lay media. This should not cause the plastic surgeon to avoid the procedure, but rather should promote deeper knowledge of the basic pathophysiology. All means to accomplish the surgery in the safest possible way should be utilized, to minimize the risk of complications, especially the most severe risks. This article reviews the literature on liposuction-induced fat embolism, which is often associated with severe complications in the postoperative period, and even fatal outcomes. In addition, this study highlights several preventive measures that can be adopted to ensure greater safety of this procedure.

Keywords: Plastic surgeon; Liposuction; Fat embolism; Pulmonary embolism.

■ **RESUMO**

A cirurgia de lipoaspiração é com alguma frequência relacionada a consequências dramáticas ou fatais, causando grande repercussão no meio médico e principalmente na mídia leiga. Esse fato não deve fazer com que o cirurgião plástico evite essa cirurgia, mas sim estimulá-lo a conhecer profundamente a fisiopatologia inerente ao procedimento, buscando meios embasados de realizá-lo da forma mais segura possível, reduzindo ao máximo os riscos de complicações, principalmente as mais graves. Esse artigo teve o objetivo de realizar uma revisão bibliográfica a respeito especificamente da embolia gordurosa causada pela lipoaspiração, relacionada inúmeras vezes a pós-operatórios dramáticos e fatais. Além disso, ressalta alguns cuidados preventivos para uma maior segurança com esse procedimento.

Descritores: Cirurgia plástica; Lipoaspiração; Embolia gordurosa; Embolia pulmonar.

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INTRODUCTION

Liposuction is among the most commonly performed plastic surgeries worldwide[1]. In the last 30 years, it has become increasingly safe[1-5]. However, it is not free from serious risks of complications[4-7], including death. These complications are poorly understood and may cause many patients to fear the procedure.

The most common complications are less severe, and include irregular appearance, hematoma, seroma, edema, sagging skin, and hyperpigmentation, none of which have major repercussions[4,8]. However, less frequent serious complications do occur, and include infection, necrotizing fasciitis, skin necrosis, perforation of the abdominal cavity, deep vein thrombosis, pulmonary thromboembolism, lidocaine and epinephrine toxicity, hypovolemic shock, and fat embolism[2,4-7]. The incidence of death varies among the studies published on this topic[5,7,9-12]. However, there is a consensus that even a single case is tragic, since this elective aesthetic surgery is often performed on an outpatient basis.

When reviewing the literature on the most severe and troubling complications of liposuction, we found a number of experimental studies on fat embolism, which presented intriguing results. This raised at least one concern that perhaps we are routinely performing a procedure without knowing its real consequences.

This article reviews the literature regarding actual clinical experience and risk related to liposuction-induced fat embolism. By extension, the article offers a rationale for practicing this surgery in a safe and reliable manner, as well as the need to convey an even greater sense of safety to patients.

LIPOSUCTION ASSOCIATED WITH FATAL OUTCOMES

The main causes of death associated with liposuction include pulmonary thromboembolism, visceral perforation, intoxication by anesthetic drugs, heart failure, extensive infection, hemorrhagic shock, and pulmonary fat embolism. The factors related to an increased risk of complications include excessive infiltration of anesthetic solution, large lipoaspirate volume, combined surgeries, inappropriate indications, and procedures performed in inappropriate environments[7,13].

The reported incidence of mortality and the frequencies of associated causes vary in the literature. Among these causes, pulmonary fat embolism is always reported[6,8-12], although it is not the most frequently cited or is not cited at all in many studies. In a large-scale investigation by Grazer and de Jong in 2000[9] through census data research, the mortality rate due to liposuction was 19.1/100,000, and the main causes were pulmonary thromboembolism (23.1%), visceral perforation (14.6%), anesthesia/medication toxicity (10%), fat embolism (8.5%), heart failure (5.4%), extensive infection (5.4%), and hemorrhagic shock (4.6%). Similar mortality rates were found in a random survey by the American Board of Plastic Surgeons in 1997 (20.6/100,000), and by Teimourian and Rogers[14] between 1984 and 1987 (12.7/100,000). Pulmonary thromboembolism continues to be the complication most responsible for fatal outcomes associated with liposuction (23.4 ± 2.6%)[9]. However, Lehnhardt in 2008[7] reported 72 cases with severe complications and 23 with fatal outcomes in Germany; the main complications were necrotizing fasciitis and sepsis (27), which resulted in 14 deaths (60.8% of all deaths). However, most surgeons involved in these complications were reported to not be experts (76.3%) and performed the procedure in inappropriate environments.

FAT EMBOLISM SYNDROME (FES)

FES most commonly occurs in long bone fractures. It presents as severe respiratory failure and adult respiratory distress syndrome. The main findings associated with FES are central nervous system changes and petechiae, and minor signs are tachycardia, fever, retinal and urinary changes, low hematocrit, thrombocytopenia, lipids in sputum, and increased VHS[15].

The etiopathogenesis of FES occurs in two phases, one mechanical, and the other biochemical, which have been described immediately after major trauma and intramedullary orthopedic procedures[16-19]. In the first phase, lipid microfragments reach the circulation due to the rupture of small blood vessels and damage to adipocytes caused by liposuction. These fat emboli promote the mechanical obstruction of pulmonary capillaries and distant organs. In the biochemical phase, fat droplets are hydrolyzed by lipases produced by pneumocytes after reaching lung capillaries, releasing free fatty acids, which are toxic to endothelial and alveolar cells. This leads to an inflammatory process, characterized by hemorrhage, edema, and interstitial and alveolar lesions.

Clinical picture

When FES occurs after trauma, it is classified as fulminant acute, subacute, or subclinical[20]. The first occurs within a few hours after trauma, and results in respiratory failure, coma, and multiple organ failure. Subacute FES is characterized by respiratory failure, central nervous system changes, and petechiae. Subclinical FES manifests with benign signs of mild dyspnea and

tachycardia, and mild neurological symptoms, such as drowsiness or irritability. In the diagnostic phase of the disease, chest radiography can show the presence of a bilateral, symmetric interstitial-alveolar infiltrate; with computed tomography, this may be represented by areas of consolidation and opacification, described as "frosted glass" and micronodules[21,22].

Treatment

There is no specific treatment for FES, but clinical supportive measures, hemodynamic stabilization, and oxygen or mechanical ventilation therapy with alveolar recruitment can be given in the most severe cases[18,21]. Several studies show some benefit from the prophylactic use of corticosteroids in trauma with long bone fractures[23], although their therapeutic use has not yet been standardized. However, some services routinely administer corticosteroids to reduce the inflammatory response. A vena cava filter has been used in high-risk cases of severe trauma[13], although further studies are required to support its use. Moreover, it is hardly appropriate in liposuction surgery for aesthetic body contouring.

Liposuction and risk of fat embolism

A number of studies in the literature demonstrate attempts to assess the real risk of fat embolism due to liposuction. Some *investigations* analyzed peripheral blood lipids in patients who underwent liposuction; these showed changes in the postoperative period, with an increase in the first few hours, and a return to normal values a few hours after surgery[24]. Experimental studies in rats and pigs showed that liposuction led to hematogenous dissemination of fat particles. A cumulative effect was observed in relation to procedure duration and quantity of lipoaspirate, through the microscopic detection of fat macromolecules in serially sampled central venous blood, and pulmonary histology showing extensive fat deposits in animals submitted to this procedure[25-27]. In view of the data obtained from experimental studies, even greater preventive measures against fat embolism should be adopted in liposuction surgeries, with the avoidance of prolonged procedures and large volumes of aspirate.

These studies did not make it possible to assess the real risk of fat embolism. However, we cannot ignore the evidence that possibly all patients undergoing liposuction experience some degree of blood and pulmonary dissemination of fat particles, although insufficient to cause clinical repercussions. Some patients with a subclinical condition may be underdiagnosed. Therefore, we cannot predict the true medium- and long-term likelihood that asymptomatic patients may present with pulmonary fat deposits that result in an inflammatory response.

CONCLUSION

The occurrence of fat embolism after liposuction may be more significant than what is apparent, although no clinical studies have yet quantified the true risk. The best treatment is prevention. The surgeon must not neglect this potential complication, and should take maximum precautions with respect to the main risk factors associated with this procedure, such as avoiding large lipoaspirate volumes and prolonged and combined surgeries. In addition, it is essential to properly select patients and perform these surgeries in environments that are safe and prepared for appropriate clinical support in the event of complications.

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