

FAT EMBOLISM AS A COMPLICATION AFTER SURGERY – ABDOMINOPLASTY IN COMBINATION WITH LIPOSUCTION. LITERATURE REVIEW

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Abstract

Fat embolism is a polyetiological disease and still remains common, which is an urgent problem of our time. It occurs due to the ingress of adipose tissue into the lumen of the vessel, which causes its blockage. At the same time, a trend towards an increase in the incidence is observed everywhere.

The purpose of this work is to analyze the literature data on the topic: fat embolism in plastic surgery after surgery - abdominoplasty in combination with liposuction.

Material and methods. We systematically searched the literature and selected sources from MEDLINE, Cochrane databases, Google Scholar, PubMed, as well as research papers and online educational publications in English and Russian. Forty papers that met the inclusion criteria were included.

Results. The review article presents methods for the prevention and treatment of patients with fat embolism, pathogenesis and stages of development of this pathological condition, as well as methods for choosing treatment tactics.

Conclusion. Thus, there are many opinions on the treatment of fat embolism and there is no single standardized protocol for managing patients. After analyzing the reviewed information, we came to the conclusion that therapeutic measures should be aimed at stopping the main clinical manifestations of an injury or disease.

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Conflict of interest

The authors declare that they have no conflicts of interest

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Липосакциямен қосарланған абдоминопластикадан кейінгі асқыну ретіндегі май эмболиясы. Әдебиет шолуы

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Аңдатпа

Май эмболиясы - полиэтиологиялық ауру және әлі күнәе дейін кең таралған, қазіргі таңда өзектілігін жоймаған күрделі мәселе. Бұл май тінінің қантамырларына енуіне байланысты пайда болып, одан кейін оның бітелуіне әкеледі. Сонымен қатар, барлық жерде осы аурудың өсу тенденциясы байқалады.

Жұмыстың мақсаты – липосакциямен біріктірілген абдоминопластика отасынан кейінгі май эмболиясы туралы әдеби деректерді талдау.

Материал және әдістер. Біз әдеби деректерді MEDLINE, Кокран дерекқоры, Google Scholar, PubMed базаларында, сонымен қатар ағылшын және орыс тілдеріндегі ғылыми-зерттеу жұмыстары мен онлайн басылымдар бойынша жүйелі түрде шолу жасадық.

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Түйін сөздер:

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Нәтижелер. Шолу мақаласында май эмболиясына шалдыққан науқастардың алдын-алу және емдеу әдістері, патогенез және осы патологиялық жағдайдың даму кезеңдері, сонымен қатар емдеу тактикасын таңдау әдістері келтірілген.

Қорытынды. Осылайша, май эмболиясын емдеу туралы көптеген пікірлер бар және осындай науқастарды емдеу шараларының бірыңғай стандартталған хаттамасы жоқ. Қарастырылған ақпаратты талдағаннан кейін біз емдеу шаралары жарақаттың немесе аурудың негізгі клиникалық көріністерін тоқтатуға бағытталуы керек деген қорытындыға келдік.

Жировая эмболия как осложнение после абдоминопластики в комбинации с липосакцией. Обзор литературы

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Аннотация

Жировая эмболия – полиэтиологическое заболевание и до сих пор остается распространенным, которая является актуальной проблемой современности. Оно возникает вследствие попадания в просвет сосуда жировой ткани, что вызывает его закупорку. При этом повсеместно наблюдается тенденция к росту заболеваемости.

Целью данной работы является анализ литературных данных на тему: жировая эмболия в пластической хирургии после оперативного вмешательства – абдоминопластика в комбинации с липосакцией.

Материал и методы. Мы провели систематический поиск литературных данных и отобрали источники из MEDLINE, базах данных Кокрейна, Google Scholar, PubMed, а также исследовательские работы и учебные онлайн-издания на английском и русском языках. Были включены сорок работ, которые удовлетворяли критериям включения.

Результаты. В обзорной статье приведены методы профилактики и лечения пациентов с жировой эмболией, патогенез и стадии развития данного патологического состояния, а также приведены методы выбора тактики лечения.

Выводы. Таким образом, существует множество мнений по лечению жировой эмболии и нет единого стандартизованного протокола ведения пациентов. После анализа просмотренной информации мы пришли к выводу, что лечебные мероприятия должны быть направлены на купирование основных клинических проявлений травмы или заболевания.

Relevance

Fat embolism is a polyethological disease and still remains widespread, which is an urgent problem of our time. It occurs as a result of fat emulsion entering the lumen of the vessel, which causes its blockage. At the same time, there is a tendency to a constant increase in morbidity everywhere. Abdominoplasty or abdominal dermolipectomy is a well-established procedure for improving the contour of the body in aesthetic plastic surgery with more than 100 years of experience since its first publication by Kelly in 1899 [1,2].

Abdominoplasty has a higher level of complications than other aesthetic procedures. Despite the modern history, it is about 50 years old, the main stages of skin resection and umbilical transposition have remained unchanged, currently it is often performed

in combination with liposuction [3,4] The purpose of this work is to analyze the literature data on the topic: fat embolism in plastic surgery after surgery – abdominoplasty in combination with liposuction.

Material and methods

We conducted a systematic search of literature data and selected sources from MEDLINE, Cochrane databases, Google Scholar, PubMed, as well as research papers and online educational publications in English and Russian. Forty works that met the inclusion criteria were included.

Inclusion criteria

We included 40 sources that met our inclusion criteria: works in which studies were conducted in patients with fat embolism, sources published no later than 10 years.

Reliability assessment and data extraction

We tried to evaluate a sample of 30 sources in which attention was paid to the treatment and prevention of this pathological condition. We evaluated the articles in random order based on key aspects. The data elements taken for this article included: study design, sampling method, number of patients and operations performed, outcome determination, randomized controlled trials.

Results

Abdominal dermolipectomy is an extensive surgical operation, usually accompanied by a significant number of local and general complications. Some studies show that the risk of severe complications, including mortality, ranges from 1 to 617 to 1 in 2320 cases [3].

In an extensive review of 10,940 abdominoplasty operations performed by 958 plastic surgeons from all over the world, complications were associated with embolism in 1.9% of cases, and the frequency of complications after abdominoplasty can reach 80% in obese patients [4].

According to foreign authors, the body mass index (BMI) plays an important role: namely, a BMI of more than 30 only increases the operational time, hospital stay, duration of drainage and the number of drains [5,6,7].

According to other authors, among all aesthetic operations performed on an outpatient basis, in the period from 2001 to 2011, 414 resulted in embolic complications. Of these, 240 (58%) were cases of abdominoplasty. The predictors of embolism were: age over 40 years and body mass index over 25 kg/m² [8,9].

Death after abdominoplasty is rare in the literature, but the incidence of the disease ranges from 0.04% to 0.16%. Most deaths were associated with massive pulmonary embolism. However, these statistics do not take into account abdominoplasty performed by non-certified plastic surgeons [10,11,12].

There are various theories of the occurrence of this pathological condition, the colloidal-chemical theory is considered to be dominant, which consists in the fact that under the influence of trauma and concomitant arterial hypotension, hypoxia, hypercatecholemia, platelet activation and coagulation factors, neutral fat is transformed into free fatty acids, which then form globules in the process of reesterification, clogging the lumen of capillaries thereby causing fat embolism clinic.

Mechanical theory also has a right to exist (liquid fat from the bone marrow, subcutaneous fat gets into the bloodstream) and enzymatic theory (lipase activation violates the dispersion of plasma own fats), but most authors are critical of them.

There are pulmonary, cerebral and, most often, mixed forms. According to the duration of the latent period, it is proposed to distinguish the following forms of fat embolism:

- lightning-fast, which leads to the death of the patient within a few minutes;
- acute, develops in the first hours after injury or surgery;

- subacute - with a latency period of 12 to 72 hours.

The acute course is characterized by the development of the clinical picture of fat embolism in the first hours after injury - a lightning form.

Under these conditions, massive damage, as a rule, leads to the rapid entry of a huge amount of fat globules into the vascular bed and lungs.

The symptoms of fat embolism include manifestations occurring in various diseases: respiratory, brain and skin (the classical triad of fat embolism occurs only 0.5% to 2.0%): [13,14,15,16].

- Arterial hypoxemia (PaO₂ <60-70 mmHg, SpO₂ < 90-92%);
- Signs of acute respiratory distress syndrome (usually with severe fatty embolism);
- Central nervous system dysfunction (motor restlessness, seizures, delirium, coma);
- Petechial rashes develop 24-36 hours after injury or surgery in 30-60% of patients with FE. They are localized in the upper half of the trunk, more often in the axillary region. Hemorrhages on the mucous membrane of the mouth, the membranes of the eyes and the conjunctiva are also characteristic. Usually the rash disappears within 24 hours;
- Sudden decrease in hemoglobin;
- Thrombocytopenia, or a rapid decrease in the number of platelets, a decrease in the level of fibrinogen;
- Detection of neutral fat in blood, urine, cerebrospinal fluid, sputum (fat is detected in alveolar macrophages);
- Detection of fat during skin biopsy in the area of petechiae;
- Detection of fatty retinal angiopathy.

Pulmonary disorders with fatty embolism are observed in 75% of patients and are often the first clinical symptoms of the disease. Patients experience a feeling of tightness and pain behind the sternum, increasing anxiety, shortness of breath, cyanosis of the face, acrocyanosis. The severity of symptoms and the degree of respiratory insufficiency characterizes the severity of lung damage, which is more often characteristic of pulmonary embolism, however, it is necessary to remember and exclude fatty embolism of the lungs.

Neurological manifestations occur in general in 80% of patients with fat embolism, and usually precedes the development of respiratory symptoms for 6-12 hours. Neurological disorders in the absence of pulmonary or dermatological manifestations at the initial stage of the disease may delay the diagnosis of cerebral fat embolism, and may lead to erroneous patient management tactics. [17,18,19,20].

From the cardiovascular system - symptoms of pulmonary embolism, but this is not a reliable sign [21,22,23].

Criteria for the diagnosis of fat embolism syndrome:

The diagnosis of "fat embolism syndrome" is usually made in the presence of at least one "large" criterion and four "small" ones.

The presence of axillary or subconjunctival petechiae, a sharp deterioration of the condition within 4-6 hours, hypoxemia and cerebral symptoms

(euphoria, confusion), which cannot be explained by the existing hypoxemia and pulmonary disorders, are considered to be great criteria.

Small criteria include tachycardia > 110 beats per minute, hyperthermia > 38.5°C, emboli in the fundus vessels, drops of fat in urine, unexplained thrombocytopenia, decreased hematocrit, increased erythrocyte sedimentation rate, fat globules in sputum.

Additional criteria are the development of clinical symptoms within 72 hours, shortness of breath, altered mental status and urinary incontinence [24,25,26,27].

The main recommendations for the prevention of complications according to the principles of evidence-based medicine [28,29]:

1. Careful selection of the patient ("American Society of Anesthesiologists" ASA class I, within 30 percent of the ideal body weight);
2. The use of tight infiltration methods during liposuction;
3. Careful monitoring of the state of the injected and withdrawn fluid (urinary catheterization for non-invasive hemodynamic monitoring, communication with an anesthesiologist);
4. Introduction of infusions
5. Long-term monitoring of patients in the appropriate medical institution;

To date, no means of effective drug prevention and treatment of fat embolism have been proposed, therefore, therapeutic measures should be aimed at relieving the main clinical manifestations of injury or disease: blood loss, hypovolemia, shock, coagulopathy, acute respiratory failure and others. Replenishment of the circulating blood volume and correction of the water-electrolyte balance is carried out depending on the type of dyshydria using colloidal and crystalloid solutions. The correct selection of infusion and rheological therapy that eliminates peripheral vascular spasm helps to reduce the risk of reperfusion complications, which are an important pathogenetic link of fat embolism [30,31].

References

1. Alderman A.K, Collins E.D, Streu R, Grotting J.C, Sulkin A.L, Neligan P, Haecck P.C, Gutowski K.A. *Plast Reconstr Surg*. 2009 год; 124 (6): 2127-33.
2. Momeni A, Heier M, Bannasch H, Stark G.B. Complications of Abdominoplasty: Analysis of Risk Factors. *J Plast Reconstr Aesthet Surg*. 2009; 62 : 1250-4
3. Mejia J.A, Cárdenas Castellanos Y.A. *Aesthetic Plast Surg*. 2012 Apr; 36(2): 278-84.
4. Wagih Ghnnam,* Ashraf Elrahawy, and Magdy EL Moghazy. The Effect of Body Mass Index on Outcome of Abdominoplasty Operations *World J Plast Surg*. 2016 Sep; 5(3): 244–251.
5. Keyes G.R, Singer R, Iverson R.E, Nahai F. Incidence and Predictors of Venous Thromboembolism in Abdominoplasty. *Aesthet Surg J*. 2018 Feb 17; 38(2):162-173. doi: 10.1093/asj/sjx154.
6. Cerebral Fat Embolism: A diagnostic challenge. Babita Gupta, Manpreet Kaur. 2011. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3168363/>.
7. Fat Embolism Syndromes Following Liposuction. Hui-Dong Wang, Jiang-Hong Zheng, Chen-Liang Deng, Qin-Yang Liu, Song-Lin Yang. 2009y. <http://link.springer.com/article/10.1007%2Fs00266-008-9183-1>.
8. Advances in Liposuction: Five Key Principles with Emphasis on Patient Safety and Outcomes. Geo N. Tabbal, MD,* Jamil Ahmad, MD, 2013y. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4186292/>.
9. Advances in Liposuction: Five Key Principles with Emphasis on Patient Safety and Outcomes. Geo N. Tabbal, MD,* Jamil Ahmad, MD, 2013y. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4186292/>.
10. Zyryanova O.A. Fat embolism as severe complication of skeletal injury. Region. Ecology and medicine in the Eastern region [Zhirovaja jembolija kak tjazheloe oslozhenie skeletnoj travmy. Region. Jekologija i medicina v Vostochnom regione]. 2010, 111 p.

It is known that alcohol is able to inhibit serum lipase, while being a good emulsifier, and also has anti-ketogenic, sedative and analgesic effects.

Some authors believe that medications such as steroids, heparin, alcohol and dextran are recognized as ineffective. [32], and other authors give an example that corticosteroids reduce the risk of fat embolism by 78%. With low doses (for example, 6 mg / kg for 48 hours in 6 divided doses) [33,34,35].

A number of authors recommend the use of anticoagulants, in particular, heparin [36,37].

A clinical case of fat embolism in a 64-year-old patient was also described, after total knee replacement, a clinic of fat embolism of the brain and lungs developed. Drug therapy included heparin. The patient showed a gradual improvement in respiratory and neurological status and no further complications were noted [38,39].

Also, the basic drug prevention of fat embolism includes the administration of heparin 5000 units 4 times a day under the control of a coagulogram. However, lipase activation is potentially dangerous, since an increase in free fatty acids is an important part of the pathogenesis of fat embolism [40].

Conclusion

Thus, there are many opinions on the treatment of fat embolism and there is no single standardized protocol for the management of patients.

Early diagnosis is particularly difficult, due to the lack of a clear clinical picture and pathognomonic symptoms, and laboratory diagnosis is not very specific. After analyzing the reviewed information, we came to the conclusion that therapeutic measures should be aimed at relieving the main clinical manifestations of the pathological condition, qualified nursing care in the postoperative period with an emphasis on the emotional state is needed, as well as strict dynamic monitoring, strict performance of abdominoplasty in combination with liposuction in medical centers with a developed intensive care service.

11. S. Samuel Bederman, MD,* Mohit Bhandari, MD, Michael D. McKee, MD and EmilH. Schemitsch, MD Do corticosteroids reduce the risk of fat embolism syndrome. *Meta-analysis.* v.52(5); 2009 Oct. PMC2769117
12. Author: Soo Hyun Yeoa, Hyuk Won Changa, d, Sung IISohnb, Chul Hyun Choc, Ki-Cheor Bae. Pulmonary and Cerebral Fat Embolism Syndrome After Total Knee Replacement. 2013y.
13. Clinical effectiveness analysis of dextran 40 plus dexamethasone on the prevention of fat embolism syndrome. Author: Xi-Ming Liu,1,* Jin-Cheng Huang,2,* Guo-Dong Wang,1 2014y. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4161593>
14. Gumanenko E.K., Samokhina I.M. (2011). Military field surgery of local wars and armed conflicts: a guide [Voенно-polevaja hirurgija lokal'nyh vojn i vooruzhennyh konfliktov: rukovodstvo]. Chapter 22.531 page
15. de Lima ESR, Apgaua BT, Milhomens JD, et al. Severe fat embolism in perioperative abdominal liposuction and fat grafting. *Braz J Anesthesiol.* 2016;66(3):324–328.
16. Erba P, Farhadi J, Schaefer DJ, Pierer G. Fat embolism syndrome after combined aesthetic surgery. *J Plast Surg Hand Surg.* 2011;45(1):51–53.
17. Byeon SW, Ban TH, Rhee CK. A case of acute fulminant fat embolism syndrome after liposuction surgery. *Tuberc Respir Dis (Seoul).* 2015;78(4):423–427.
18. Thomas M, Menon H, D'Silva J. Surgical complications of lipoplasty-management and preventive strategies. *J Plast Reconstr Aesthet Surg* 2010;63:1338-43.
19. Conkbayır C, Kenan S, Emirođlu O. Massive pulmonary thromboembolism after abdominoplasty and liposuction. *Turk Kardiyol Dern Ars* 2011;39:410-3.
20. Fodor PB. Reflections on lipoplasty: History and personal experience. *AesthetSurg J* 2009;29:226-31
21. Li S. Zheng Xing Waikexue. Vol. 1. Beijing: People's Medical Publishing House Co. Ltd; 2009. p. 710.
22. Kwiat ME, Seamon MJ. Fat embolism syndrome. *Int J Crit Illn Inj Sci* 2013;3:64-8.
23. S.S. Bederman, M. Bhandari, M.D. McKee, et al. Do corticosteroids reduce the risk of fat embolism syndrome in patients with long bone fractures? *Can J Surg.* 52 (2009), pp. 386-393.
24. S. Akhtar. Fat embolism. *Anesthesiol Clin.* 27 (2009), pp. 533-550
25. Senen D, Atakul D, Erten G, Erdođan B, Lortlar N. Evaluation of the risk of systemic fat mobilization and fat embolus following liposuction with dry and tumescent technique: an experimental study on rats. *Aesthetic Plast Surg.* 2009;33(5):730-7. DOI: <http://dx.doi.org/10.1007/s00266-009-9396-y>
26. Bederman SS, Bhandari M, McKee MD, Schemitsch EH. Do corticosteroids reduce the risk of fat embolism syndrome in patients with long-bone fractures? A meta-analysis. *Can J Surg.* 2009;52(5):386-93.
27. Wang A.Z, Ma Q.X, Zhao H.J, Zhou Q.H, Jiang W, Sun J.Z. A comparative study of the mortality rate of rats receiving a half lethal dose of fat intravenously: under general anaesthesia versus under spinal anaesthesia. *Injury.* 2012;43(3):311-4. DOI: <http://dx.doi.org/10.1016/j.injury.2011.08.022>
28. Franco F.F, Tincani A.J, Meirelles L.R, Kharmandayan P, Guidi M.C. Occurrence of fat embolism after liposuction surgery with or without lipografting: an experimental study. *Ann Plast Surg.* 2011;67(2):101-5. PMID: 21301303 DOI: <http://dx.doi.org/10.1097/SAP.0b013e3181fe32b6>.
29. Eriksson EA, Pellegrini DC, Vanderkolk WE, Minshall CT, Fakhry SM, Cohle SD. Incidence of pulmonary fat embolism at autopsy: an undiagnosed epidemic. *J Trauma.* 2011;71(2):312-5. DOI: <http://dx.doi.org/10.1097/TA.0b013e3182208280>
30. Felzemburgh V.A, Barbosa R.C, Nunes V.L, Campos J.H. Fat embolism in liposuction and intramuscular grafts in rabbits. *Acta Cir Bras.* 2012;27(5):289-93. DOI: <http://dx.doi.org/10.1590/S0102-86502012000500002>.
31. Terranova C, Sartore D, Snenghi R. Death after liposuction: case report and review of the literature. *Med Sci Law.* 2010;50(3):161-3.
32. Franco F.F, Tincani A.J, Meirelles L.R, Kharmandayan P, Guidi M.C. Occurrence of fat embolism after liposuction surgery with or without lipografting: an experimental study. *Ann Plast Surg.* 2011;67(2):101-5.
33. Senen D, Atakul D, Erten G, Erdogan B, Lortlar N. Evaluation of the risk of systemic fat mobilization and fat embolus following liposuction with dry and tumescent technique: an experimental study on rats. *Aesthetic Plast Surg.* 2009;33(5):730-7
34. Park SY, Jeong WK, Kim MJ, Lee KM, Lee WS, Lee DH. Necrotising fasciitis in both calves caused by *Aeromonascaviae* following aesthetic liposuction. *J Plast Reconstr Aesthet Surg.* 2010;63(9):e695-8.
35. Kattapuram TM, Avery LL. Ureteral tear at the ureteropelvic junction: a complication of liposuction. *Emerg Radiol.* 2010;17(1):79-82
36. Zandi I. Blindness: a rare complication of liposuction: report of a case of unilateral blindness; notes on the effect of compassionate care. *Plast Reconstr Surg.* 2009;123(6):211e-2e.
37. Choi H, Shin T. Rupture of a deep circumflex iliac artery after abdominal liposuction: treatment with selective arterial transcatheter embolization. *Cardiovasc Intervent Radiol.* 2009;32(6):1288-90.
38. Sociedade Brasileira de Cirurgia Plástica. Cirurgiaplástica no Brasil. Pesquisa Datafolha 2009. Disponível em: <http://www2.cirurgiaplastica.org.br/images/Docs/pesquisa2009.pdf>.
39. American Society of Plastic Surgeons. Top 5 cosmetic procedures: statistics. Disponível em: <http://www.plasticsurgery.org/Documents/news-resources/statistics/2009-statistics/2009-top-5-cosmetic-surgery-procedures-graph.pdf>.
40. Martín Coronado-Malagón, MD, Porfirio Visoso-Palacios, MD, C. Alejandro Arce-Salinas, MD. Fat Embolism Syndrome Secondary to Injection of Large Amounts of Soft Tissue Filler in the Gluteal Area. *Aesthetic Surgery Journal*, Volume 30, Issue 3, May/June 2010, P. 448–450, <https://doi.org/10.1177/1090820X10373381>.