



Pneumothorax as a Complication of Liposuction

James A. Mentz, BA; Henry A. Mentz, MD; and Stephanie Nemir, MD

Aesthetic Surgery Journal
2020, Vol 40(7) 753–758
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DOI: 10.1093/asj/sjaa029
www.aestheticsurgeryjournal.com

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Abstract

Background: Pneumothorax is a rare complication of liposuction resulting from injury to the lung parenchyma.

Objectives: This study aimed to determine the incidence of pneumothorax complicating liposuction, describe an archetypal presentation, identify risk factors, and propose options for risk reduction.

Methods: In a retrospective chart review, liposuction procedures performed over a 16-year period by 8 surgeons in 1 practice were screened for pneumothorax. Cases featuring pneumothorax were analyzed to ascertain risk factors, presentation, and pathogenesis.

Results: Among the 16,215 liposuction procedures performed during the study period, 7 pneumothoraxes were identified (0.0432%). Six (85.7%) were female. Three (42.9%) had previous liposuction. Six cases (85.7%) included liposuction of the axillary region. All cases featured depression of intra/postoperative oxygen saturations as the initial sign. Three (42.9%) were identified intraoperatively. All patients were transferred to a hospital for imaging. Five (71.4%) underwent chest tube placement. Two (28.6%) were treated with observation alone. Pneumothoraxes were left-sided in 4 cases (57.1%), and right-sided in 3 cases (42.9%). In early cases, 1.5-mm infiltration cannulas were used; in 2016 cannula size was changed to 3–4 mm for infiltration and 4–5 mm for liposuction.

Conclusions: Possible risk factors for pneumothorax include liposuction of the axilla, use of flexible infiltration cannulas, and scarring from previous liposuction. We recommend including pneumothorax as a potential complication during informed consent, performing infiltration with a stiff >3.5-mm cannula, minimizing positive-pressure ventilation, emphasized awareness of cannula tip location in all patients but particularly in patients with previous liposuction or scar tissue, and increased caution when operating in the axillary area.

Level of Evidence: 4

Editorial Decision date: January 23, 2020; online publish-ahead-of-print January 31, 2020.



Pneumothorax is the accumulation of gas within the pleural space. It is a rare complication of several plastic surgical procedures, including breast augmentation¹ and abdominoplasty.² Pneumothoraxes may occur spontaneously or as a result of direct trauma to the lung or chest wall.

In a surgical setting, traumatic pneumothoraxes are caused by intraoperative laceration of the pleura, needle puncture with injection of local anesthetic, or barotrauma

Mr Mentz is an MD Candidate, Baylor College of Medicine, Houston, TX. Dr Mentz is a plastic surgeon in private practice in Houston, TX. Dr Nemir is a Clinical Specialist, University of Texas MD Anderson Cancer Center, Houston, TX.

Corresponding Author:

Mr James A. Mentz, 6301 Almeda Road #512, Houston, TX 77021, USA.
E-mail: mentz@bcm.edu

as air is forced into the pleural cavity as a result of increased pressure in the surgical pocket.² Iatrogenic trauma may create a lung laceration that allows air to escape into the pleural space and not return, creating a “ball valve” effect. This is called a tension pneumothorax and leads to a potentially lethal progressive buildup of air and tension which is magnified under positive-pressure ventilation.³ Tension pneumothorax can also follow spontaneous pneumothorax, although such cases are less common.

Spontaneous pneumothoraxes may also occur during surgery, as a variety of disease processes can weaken the lung tissue, allowing the formation of blebs and bullae which are prone to rupture during surgery due to high ventilation pressure and spikes in pulmonary pressure during a change of oxygen tank or intraoperative position changes.^{2,4,5}

Although recognized as a possible complication of liposuction, the exact incidence of pneumothorax during liposuction has not been established. In a previous study on cosmetic liposuction, Kaoutzanis et al⁶ found pulmonary complication to be the second most common complication in cosmetic liposuction with an incidence rate of 0.1%. However, it is unclear from the data what percentage of these were pneumothorax, as the authors speculate the category likely includes complications such as dyspnea, pulmonary edema, and lung collections. In a 2003 case series of 92 consecutive high-volume liposuction patients, Richards⁷ reported 3 pneumothoraxes (3.3%). All were detected postoperatively in the recovery room with desaturation and symptoms of hypoxia, and all were treated with chest tubes. In a survey of tumescent liposuction procedures performed under local anesthetic from 39 centers, Hanke et al⁸ reported 1 case of pneumothorax out of 702 procedures (0.14%). The literature regarding pneumothorax complicating liposuction is otherwise limited to case reports.⁹ Preventative safety measures have been slow to develop, but a few possible risk factors have been proposed. Richards⁷ considered that thinner tumescent cannulas created a higher risk because of their flexibility and recommended switching to stiffer cannulas. Keyes et al¹⁰ suggested that liposuction in areas of the posterior back and thoracic cage increases risk because of the fibrous nature of the adipose tissue and proximity to the pleural space.

Given the paucity of data available in the literature, it is difficult to appropriately counsel the surgical patient as to the risk of this complication. In this retrospective review, the authors will discuss the incidence of pneumothorax complicating liposuction in a single cosmetic surgery center, evaluate potential risk factors, and provide recommendations to minimize risk.

METHODS

A retrospective review was performed of patients undergoing liposuction by 1 of 8 surgeons at a single cosmetic

surgery center (The Aesthetic Center for Plastic Surgery, Houston, TX) over a 16-year period from November 2001 to December 2017. In total, 16,215 liposuction cases were identified and screened for pneumothorax complicating the procedure. Among these 16,215 cases, 7 cases of pneumothorax were identified and a thorough chart review was conducted of each.

Patients were compared across 44 variables including patient demographics (eg, age, sex, body mass index [BMI], smoking history, past medical and surgical history), peri- and intraoperative data (eg, surgeon, anesthesiologist, ASA status, airway assessment, anesthesia type, areas of liposuction, other procedures performed in the case, duration of operation), and data regarding the complication (eg, presenting signs/symptoms, vital signs, physical findings, sidedness of pneumothorax, treatment type and outcome).

This study was not subject to institutional review board scrutiny because it is a retrospective chart review of pre-existing data. In addition, the study meets criteria for waiver of informed consent:

- The research involves no more than minimal risk to the subject.
- The waiver will not adversely affect the rights and welfare of the subjects.
- The research could not practicably be done without a waiver of consent due to the large number of patients included.
- When appropriate, the subjects will be provided with pertinent information after the study.

Data obtained from the electronic medical records were deidentified prior to analysis. All studies were conducted in accordance with principles for human experimentation as defined in the Declaration of Helsinki and International Conference on Harmonization Good Clinical Practice guidelines.

RESULTS

A total of 7 cases of pneumothorax were identified out of 16,215 liposuction cases, for an incidence rate of 0.0432%. Among these cases complicated by pneumothorax, patient age ranged from 35 to 56 years with a mean of 46 [7] years. Six of the 7 cases (85.7%) were female. Three patients had a history of previous liposuction (42.9%). Six cases involved liposuction of the axillary region (85.7%). The seventh had liposuction in the areas of abdomen and waistline only. Six cases involved the use of positive-pressure ventilation at induction (85.7%). BMI ranged from 22.7 to 29.1 kg/m² with a mean of 26.4 [2.5] kg/m². Four out of 7 patients (57.1%) had BMIs in the overweight range (25-29.9 kg/m²); the others were within the normal range (18-24.9 kg/m²). A full report of the results is given in [Table 1](#).

Table 1. Patients with Pneumothorax Following Liposuction

Age, years	Sex	BMI, kg/m ²	Liposuction	Fat, mL	Onset	Symptom	Side	Treatment
46	Female	22.7	Arm, flank, inner thigh and knee	1900	Recovery room	Stridor and shortness of breath	Left	Observation
53	Male	27.1	Abdomen, flank, chest and axilla	2700	Recovery room	Reduction in O ₂ saturation	Left	Chest tube
41	Female	24.3	Flank, back and axilla	1400	Intraoperative	Reduction in O ₂ saturation	Left	Chest tube
55	Female	28	Abdomen, hip, flank, pubic, back and axilla	8500	Intraoperative	Reduction in O ₂ saturation	Right	Chest tube
35	Female	29	Arm, flank, inner and outer thigh, back and axilla	8200	Recovery room	Reduction in O ₂ saturation	Right	Chest tube
39	Female	29.1	Arm, abdomen, flank, inner and outer thigh, back, and axilla	7400	16 hours postoperatively	Pain with deep breath	Left	Observation
50	Female	24.8	Arm, abdomen, flank, inner thigh, and axilla	2500	Intraoperative	Reduction in O ₂ saturation	Right	Chest tube
Mean age, 45.6	6 female, 1 male	4 of 7 overweight (BMI 25-29.9)	6 of 7 with axillary liposuction	3 of 7 >5 L	3 intraoperative, 4 postoperative	5 of 7 with reduction in O ₂ saturation	4 left, 3 right	5 chest tube, 2 observed

BMI, body mass index.

Three cases presented intraoperatively with sudden oxygen desaturation (42.9%). The lowest saturation recorded was 85%. An additional 3 patients first presented in the postoperative care unit with tachypnea (44 breaths per minute being the highest recorded). The seventh patient remained asymptomatic (discharged with O₂ saturation of 99% and a respiratory rate of 10-12 breaths per minute) for 16 hours postoperatively before developing shortness of breath with a respiratory rate of 16 breaths per minute (14.3%).

Six of the 7 cases had unilateral decreased breath sounds on physical exam (85.7%). There were no findings of tracheal deviation or tension pneumothorax. The left side was affected in 4 cases (57.1%) and the right side in 3 cases (42.9%). There were no cases of bilateral pneumothorax.

All 7 cases were transferred to the hospital, where diagnosis was confirmed with posteroanterior (PA) chest X-ray (100%). Five cases received treatment with chest tube placement (71.4%), and 2 cases were treated with observation alone (28.6%).

DISCUSSION

Pneumothorax is thought to be a rare complication of liposuction, but the exact rate at which this condition occurs is unknown. Reports have been limited to small case series and case reports and, as with all rare complications, accurate calculation of an incidence rate requires a large data set. Research by Kaoutzanis et al⁶ is useful for establishing the rate of pulmonary complications from liposuctions

(0.1%). Our study adds to this information by describing the rate of pneumothorax in liposuction. Without data regarding incidence rates, it is difficult to counsel patients appropriately so that they may make informed decisions regarding their care. From this retrospective chart review of cases performed by 8 surgeons over 16 years in a single facility, the authors found the incidence of pneumothorax to be 7 cases per 16,215 liposuction procedures (0.0432%), or 1 case in every 2316 cases.

Our ability to draw conclusions regarding risk factors for pneumothorax in our data set is limited, because complete medical records for the entire cohort of 16,215 patients were unavailable for review. Therefore, although we are able to identify common factors among these patients and hypothesize how these factors may have increased their risk, these hypotheses remain speculative and any definitive identification of risk factors would require a more extensive study.

Common features identified in our case series were female sex (85.7%), liposuction of the axilla (85.7%), liposuction of the abdomen (57.1%), and use of positive-pressure ventilation (85.7%). Cases were fairly evenly distributed in terms of laterality, with 3 on the right (42.9%) and 4 on the left (57.1%). There were no cases of bilateral pneumothorax. History of previous liposuction was noted in 3 patients (42.9%), which is likely an overrepresentation of this group compared to their frequency within the overall data set.

Although the predominance of female patients in our series at first seems to be significant, it likely tracks

closely with the proportion of our cohort who are female. According to 2018 American Society for Aesthetic Plastic Surgery statistics, 88.9% of patients undergoing cosmetic liposuction were female,¹¹ and we would estimate a similar proportion within our own population.

Three out of 7 (42.9%) pneumothorax cases occurred in patients with previous liposuction. The exact number of patients in the sample with a history of previous liposuction is unknown, but we estimate that patients with a history of liposuction are overrepresented within our affected population. Scar tissue within the liposuction treatment area may increase the force required to move the cannula within the adipose tissue and may also impede the path of a flexible cannula and alter its direction, creating inadvertent injury. Although this does not rule out liposuction technique as the cause of the pneumothorax because the incidence is extremely low, it may be a controllable contributing factor that practitioners should be aware of. In early cases, 1.5-mm infiltration cannulas were used; in 2016 cannula size was changed to 3-4 mm for infiltration and 4-5 mm for liposuction. In our sample, no pneumothorax occurred after changing from a thin, semiflexible infiltration cannula to a stiff cannula.

Although plastic surgeons have long been aware of the potential for intrathoracic injury with liposuction of the abdomen, particularly with passage of the cannula in a cephalad direction near and over the costal margin, the risk of intrathoracic injury with liposuction of the axilla is frequently not considered. As 6 of the 7 (85.7%) pneumothoraxes occurred in cases featuring liposuction of the axillary region, liposuction of the axillary region may put patients at an increased risk for pneumothorax. This is likely due to physical proximity to the thoracic region, the curvature of the rib cage, and difficulty working around the upper extremities while balancing the patient in a lateral decubitus position. Axillary liposuction is performed in both the supine and lateral decubitus positions, and entry ports placed at the anterior and posterior axillary lines at the level of the inframammary fold can provide safe access to the axillary region (Figure 1). We anticipate that keeping the cannula tangential to the chest wall should provide a safe trajectory. Risk of chest penetration may increase with increasing angle of the cannula (Figure 2). To minimize the risk of chest penetration, the cannula should be positioned tangential to the chest wall during both tumescence infiltration and liposuction.

One case of pneumothorax was not associated with liposuction of the axillary region. In this patient, liposuction was performed in the arms, flanks, inner thighs, and knees. The authors suppose that this case may have been spontaneous or related to surgical positioning.

The exact number of patients within the sample who received liposuction of the axillary region is unknown due to

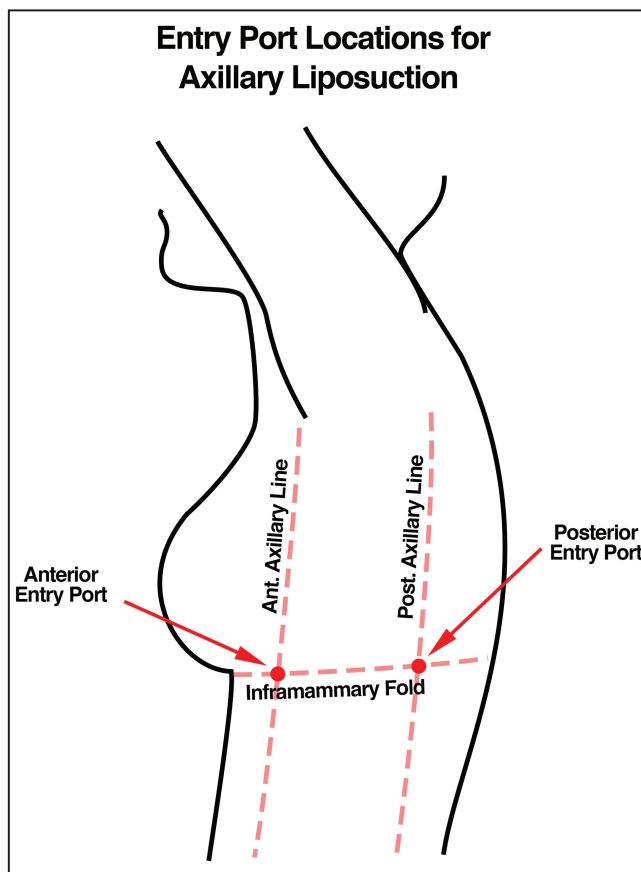


Figure 1. Entry port locations for axillary liposuction.

constraints on data collection, but a sample portion of 172 cases from a 2-month period within the study was analyzed to approximate the proportion of liposuction cases that involved this region. Out of these 172 liposuction cases, performed between January 1, 2018 and February 28, 2018, 69 cases (40.12%) involved liposuction of the axillary region. The authors believe this proportion serves as an acceptable approximation for that of the entire study sample, making the high proportion of pneumothorax complications with axillary liposuction (85.7%) particularly notable.

Six of the 7 (85.7%) pneumothorax cases were in procedures involving positive-pressure ventilation, which is a known risk factor for spontaneous pneumothorax.¹¹ Although additional pressure was only applied at induction, it may nevertheless pose some additional risk. In addition, a paper from the orthopedic literature suggests that certain operative positions are related to increased risks of pneumothorax.¹² We hypothesize that the position changes involved in multiple-area liposuction may compound the risks associated with positive-pressure ventilation. For example, if the patient is on their side while receiving positive-pressure ventilation, the endotracheal tube may slide deeper toward a right bronchial mainstem

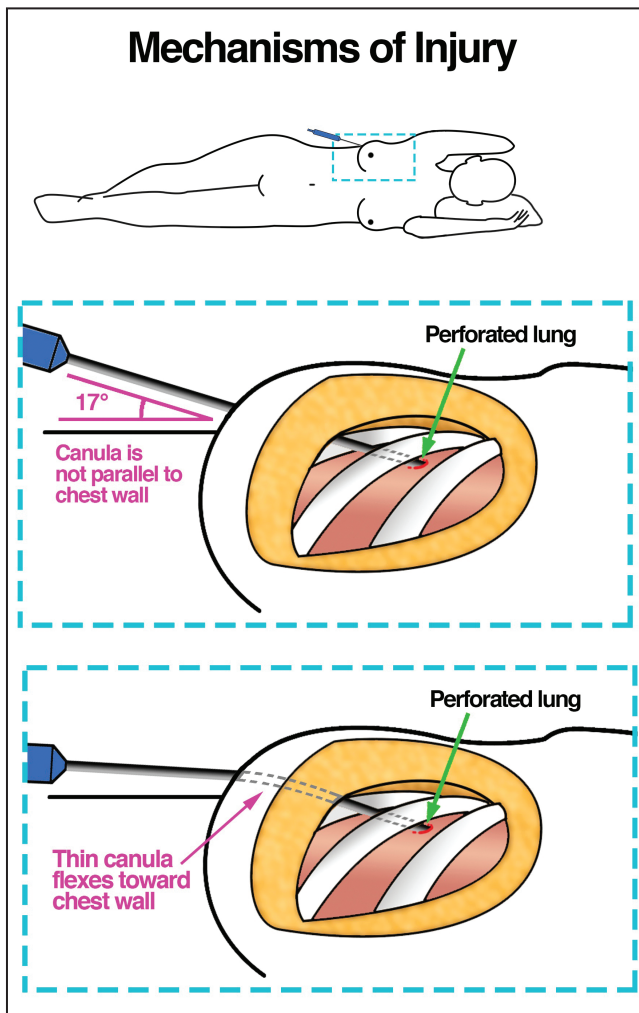


Figure 2. Mechanism of injury.

position, increasing pressure in the right lung. However, the data are insufficient to draw conclusions and further investigation is recommended.

Three cases (42.9%) were identified intraoperatively by sudden oxygen desaturation. Unfortunately, no records were made of the areas being liposuctioned at the time of desaturation. This would be useful information for further studies, and the authors recommend implementing measures to facilitate the collection of this valuable data in the future. Three cases (42.9%) were identified in the recovery room by high respiratory rate (up to 44 breaths per minute). Unilateral decreased breath sounds were detected in 6 of 7 cases (85.7%). None of the cases featured tracheal deviation.

Shortness of breath presented at some point in 4 out of 7 cases (57.1%). One case remained asymptomatic until 16 hours after the operation, when shortness of breath and unilateral decreased breath sounds manifested. All 7 cases were transferred to the hospital for imaging,

where diagnosis of pneumothorax was confirmed by upright PA chest X-ray. Five patients (71.4%) underwent chest-tube placement and 2 (28.6%) were treated with observation alone. The authors hypothesize that the mild symptomatology observed in some pneumothorax patients may lead to the underreporting of liposuction-associated pneumothorax, and therefore a high index of suspicion is necessary.

Four (57.1%) of the pneumothoraxes identified were located on the left side, and 3 (42.9%) were located on the right. We had hypothesized that there might be a significant trend in laterality related to the handedness of the surgeon, due to suboptimal positioning of the surgeon or use of a nondominant hand on the contralateral side, but this does not appear to be the case in our data set as all of the surgeons included are right-hand dominant.

The 7 cases of pneumothorax occurred in 2005, 2005, 2007, 2011, 2015, 2015, and 2016. These complications occurred with 3 different operating surgeons; once, twice, and four times per surgeon.

There are potential limitations to this study. This study is a retrospective chart review of liposuction surgeries from 8 different surgeons all practicing different techniques. This confounds the ability to determine factors associated with increased risk of pneumothorax. The patients also received liposuction in multiple body regions, and therefore we cannot be certain that axillary liposuction is the area that carries the increased risk. Our ability to draw conclusions regarding risk factors for pneumothorax is further limited by a lack of access to complete medical records of the entire cohort. We also faced challenges in operationalizing data about cannula flexibility, degree of tissue scarring, and tissue thickness.

On the basis of the results of this article and review of the literature we offer the following recommendations:

1. Consider pneumothorax as a complication of liposuction in informed consent and shared decision-making.
2. Recognize the possible variation in the timeline of symptomatology of pneumothorax. Onset of symptoms may occur intraoperatively, in the recovery room, or even after discharge.
3. Use at least a 3.5-mm (more rigid) cannula for tumescent infiltration and liposuction to reduce the possibility of deflection against fibrotic adipose tissue, previous liposuction scars, or ribs in axillary and back areas.
4. Emphasize awareness of the cannula tip position and use your second hand to gain feedback on the depth of the tip.
5. Take extra care to maintain constant awareness of the cannula tip during liposuction of the axilla. Patients with large amounts of fatty tissue or scar tissue from

previous liposuction around the axillary region may be at higher risk.

6. Maintain a high index of suspicion: any change in oxygen saturation, CO₂, and/or expiratory pressures during a liposuction procedure or changes in oxygen saturation and/or respiratory rates after a procedure should prompt an evaluation for pneumothorax. Proper evaluation requires examination, chest auscultation, and upright inspiratory and expiratory PA X-rays.
7. Have a low threshold for transfer to an emergency room in cases of suspected pneumothorax. Treatment may require a chest tube and/or observation.
8. The possibility of a tension pneumothorax warrants keeping an intracatheter, pigtail catheter, or Heimlich valve available in surgical facilities performing liposuction.

CONCLUSIONS

Although it may not be possible to eliminate the risk of pneumothorax complicating liposuction, awareness of possible risk factors along with heightened care in high-risk patients should reduce the risk and maximize safety, and we offer a number of recommendations to this effect.

Disclosures

Dr Mentz holds stock in Algeness, Alastin, and HintMD, and is a consultant for InMode and Microaire. The other authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

Funding

The authors received no financial support for the research, authorship, and publication of this article.

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