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Original Investigation

Invasive Group A *Streptococcus* Infections Associated With Liposuction Surgery at Outpatient Facilities Not Subject to State or Federal Regulation

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IMPORTANCE Liposuction is one of the most common cosmetic surgery procedures in the United States. Tumescence liposuction, in which crystalloid fluids, lidocaine, and epinephrine are infused subcutaneously before cannula-assisted aspiration of fat, can be performed without intravenous or general anesthesia, often at outpatient facilities. However, some of these facilities are not subject to state or federal regulation and may not adhere to appropriate infection control practices.

OBJECTIVE To describe an outbreak of severe group A *Streptococcus* (GAS) infections among persons undergoing tumescence liposuction at 2 outpatient cosmetic surgery facilities not subject to state or federal regulation.

DESIGN Outbreak investigation (including cohort analysis of at-risk patients), interviews using a standardized questionnaire, medical record review, facility assessment, and laboratory analysis of GAS isolates.

SETTING AND PARTICIPANTS Patients undergoing liposuction at 2 outpatient facilities, one in Maryland and the other in Pennsylvania, between July 1 and September 14, 2012.

MAIN OUTCOMES AND MEASURES Confirmed invasive GAS infections (isolation of GAS from a normally sterile site or wound of a patient with necrotizing fasciitis or streptococcal toxic shock syndrome), suspected GAS infections (inflamed surgical site and either purulent discharge or fever and chills in a patient with no alternative diagnosis), postsurgical symptoms and patient-reported experiences related to his or her procedure, and *emm* types, T-antigen types, and antimicrobial susceptibility of GAS isolates.

RESULTS We identified 4 confirmed cases and 9 suspected cases, including 1 death (overall attack rate, 20% [13 of 66]). One instance of likely secondary GAS transmission to a household member occurred. All confirmed case patients had necrotizing fasciitis and had undergone surgical debridement. Procedures linked to illness were performed by a single surgical team that traveled between the 2 locations; 2 team members (1 of whom reported recent cellulitis) were colonized with a GAS strain that was indistinguishable by laboratory analysis of the isolates from the case patients. Facility assessments and patient reports indicated substandard infection control, including errors in equipment sterilization and infection prevention training.

CONCLUSIONS AND RELEVANCE This outbreak of severe GAS infections was likely caused by transmission from colonized health care workers to patients during liposuction procedures. Additional oversight of outpatient cosmetic surgery facilities is needed to assure that they maintain appropriate infection control practices and other patient protections.

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S *Streptococcus pyogenes*, commonly referred to as group A *Streptococcus* (GAS), is transmitted person to person through respiratory droplets or direct contact. Although GAS commonly causes mild infections (eg, pharyngitis and impetigo), invasive infections (eg, pneumonia and septic arthritis) also occur. The most severe clinical manifestations are necrotizing fasciitis and streptococcal toxic shock syndrome, with case fatality rates of 24% and 36%, respectively.¹ The Centers for Disease Control and Prevention (CDC) estimates that 11 000 to 13 300 cases of invasive GAS disease and approximately 1250 to 1600 associated deaths occur annually in the United States.² The CDC surveillance data for 2000 through 2004 demonstrated that 4% of patients with invasive GAS infections had recently undergone surgery.¹ Sporadic cases and outbreaks of GAS infections attributable to colonized surgeons, anesthesiologists, and support staff have been described.³⁻⁷

The most common cosmetic surgery procedures in the United States are breast augmentation and liposuction. In 2012, board-certified specialists (plastic surgeons, otolaryngologists, and dermatologists) performed approximately 300 000 liposuction procedures.⁸ Since 1987, tumescent liposuction, in which crystalloid fluids, lidocaine, and epinephrine are infused subcutaneously before cannula-assisted aspiration of fat, has been widely used.^{9,10} This form of liposuction can be performed without intravenous or general anesthesia, often in outpatient settings. Both GAS and *Mycobacterium* species have been identified as a cause of sporadic postliposuction infections, and mycobacteriosis outbreaks have been linked to liposuction procedures.¹¹⁻²⁴

On September 17, 2012, the Maryland Department of Health and Mental Hygiene (MDHMH) was informed of 3 patients with invasive GAS infections in a hospital, including 1 fatality. All 3 patients had undergone liposuction at a single outpatient cosmetic surgery facility (facility A) in August and September 2012. Because the facility was part of a 3-state chain, state and local health departments in Maryland, Pennsylvania, and Delaware initiated a joint investigation to define the extent of transmission, identify potential modes of transmission, and recommend control measures. The CDC provided consultation and laboratory support. We report on the public health response.

Methods

Human Participants' Protection

This investigation was determined by the Pennsylvania Department of Health (PADOH) Institutional Review Board and the CDC Scientific Education and Professional Development Program Office Human Subjects' Protection Coordinator to be a nonresearch public health response. Verbal consent was obtained over the telephone at the time of patient interviews.

Case Finding

We defined a case of confirmed invasive GAS infection as isolation of GAS from a normally sterile site (eg, blood) or wound of a patient with necrotizing fasciitis or streptococcal toxic shock syndrome. Suspected GAS infection was defined as in-

flammation at the surgical site and either purulent discharge or fever and chills in a patient with no alternative diagnosis. Eligible persons were those who underwent liposuction at a member facility of the 3-state cosmetic surgery chain between July 1 and September 14, 2012, the last day liposuction procedures were conducted before the investigation began.

We attempted to contact all outpatients from that period who underwent liposuction to identify additional GAS cases. Using a standardized questionnaire, we interviewed patients by telephone regarding symptoms and medical care received. We asked patients to recall details of their liposuction experience (eg, antibiotic use and attire worn by the attending physician and assistants). Clinic records were reviewed for confirmed case patients. We also reviewed medical records of all hospitalized patients. Comparisons of cases and noncases were conducted using χ^2 test and *t* test as appropriate, with $P \leq .05$ indicating statistical significance.

The Pennsylvania, Maryland, and Delaware health departments searched routine disease surveillance databases for potential liposuction-associated GAS infections. In Maryland, invasive GAS cases reported to the MDHMH in 2012 were compared with the patient list for all procedures (including nonliposuction procedures) at facility A. The MDHMH and the PADOH issued press releases to alert the public and help identify additional cases. The MDHMH and the PADOH also issued advisories to county health officers and physicians within their respective jurisdictions.

Health Care Worker Screening for GAS Colonization

We interviewed management and staff regarding the number and location of facilities and employees. We then screened those who provided care to any of the confirmed case-patients for GAS colonization, collecting specimens from the nose, throat, and anus, as well as from the vagina and wounds if indicated.

GAS Microbiological Characterization

Swabs from health care personnel were transported to the PADOH Bureau of Laboratories or the MDHMH Laboratories Administration for bacterial culture. Available GAS isolates from health care personnel and confirmed cases were sent for molecular typing and antimicrobial susceptibility testing at the CDC *Streptococcus* Laboratory in Atlanta, Georgia. Polymerase chain reaction-based typing of the M protein gene (*emm*) and typing of T antigen were performed as previously described.^{25,26} *Emm* sequences are available in a downloadable public database (ftp://ftp.cdc.gov/pub/infectious_diseases/biotech/tsemm/). Broth dilution antimicrobial susceptibility testing was performed using a custom panel (TREK Diagnostics).

Site Visits

We assessed compliance with standard infection prevention and control practices at the sites where liposuction was performed.²⁷⁻²⁹ Site visits focused on assessment of infection prevention practices, dedicated infection prevention resources and training, health care-associated infection tracking, and adherence to standard precautions.³⁰ At the time of

these visits, liposuction procedures had been suspended, and no surgical procedures could be observed. We interviewed health care personnel to understand the procedure protocol, infection prevention measures, and training and to identify any history of symptoms consistent with GAS infections.

Results

Setting

The cosmetic surgery chain had 5 facilities in 3 states (Maryland, Pennsylvania, and Delaware). The chain offered multiple procedures (eg, filler injections and laser hair and tattoo removal) in all locations; however, office-based tumescent liposuction was performed at only 2 facilities, facility A in Maryland and facility B in Pennsylvania. In both states, the facili-

ties and procedures conducted were not under state regulation, although the physicians and nurses were licensed in 1 or more states.

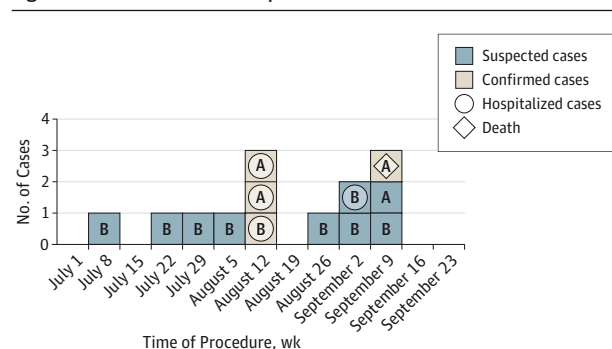
Case Description

Between July 1 and September 14, 2012, a total of 66 liposuction procedures were conducted at facility A and facility B. Patients undergoing liposuction resided in Pennsylvania, Maryland, New Jersey, and Delaware. We interviewed 55 patients (83%). Of those interviewed, 45 respondents (82%) underwent liposuction at facility B. The median age was 39 years (age range, 24-64 years); 45 patients (82%) were women. Of the patients, 53 (96%) reported perioperative antibiotic use. Health care workers interviewed stated that patients undergoing liposuction were routinely prescribed cephalexin or azithromycin. Eleven patients not interviewed seemed similar to those interviewed with respect to sex, state of residence, and the distribution of procedures by date and facility.

We identified 13 GAS cases (4 confirmed and 9 suspected), yielding an overall attack rate of 20% (13 of 66). Cases were associated with procedures conducted at both facilities (4 at facility A and 9 at facility B) between July 9 and September 11, 2012 (Figure). The highest attack rates (number of confirmed or suspected cases per liposuctions performed) were during the weeks of August 12, 2012 (30% [3 of 10]) and September 9, 2012 (50% [3 of 6]).

The 4 patients with confirmed invasive GAS infections were women aged 28 to 60 years (Table). All were hospitalized; the median time from the liposuction procedure to hospitalization was 4 days (range, 2-7 days). All had necrotizing fasciitis, 3 also had clinically significant hypotension and other signs of possible streptococcal toxic shock syndrome, and 1 died. The median duration of hospitalization was 19 days (range, 4-77

Figure. Procedure Dates of Suspected Cases and Confirmed Cases



A indicates the procedure was conducted at facility A in Maryland, and B indicates the procedure was conducted at facility B in Pennsylvania.

Table. Characteristics of Patients With Confirmed and Suspected Group A *Streptococcus* Infection

Variable	Confirmed Cases (n = 4)	Suspected Cases (n = 9)	Noncases (n = 42)
Demographics			
Age, median (range), y	44 (28-60)	35 (24-60) ^a	39 (25-59)
Female sex, No. (%)	4 (100)	8 (89)	34 (81)
Liposuction procedure, No. (%)			
>1 Body parts treated	3 (75)	2 (29) ^b	6 (18) ^b
Postoperative symptoms, No. (%)			
Redness	4 (100)	8 (89)	2 (5)
Swelling	4 (100)	7 (78)	4 (10)
Pain	4 (100)	6 (67)	4 (10)
Purulent drainage	4 (100)	7 (78)	0
Fever	3 (75)	2 (22)	0
Chills	2 (50)	3 (33)	0
Nausea	2 (50)	4 (44)	2 (5)
Vomiting	2 (50)	3 (33)	3 (7)
Medical care and diagnoses, No. (%)			
Sought medical care	4 (100)	6 (67)	3 (7)
Hospitalized	4 (100)	1 (11)	0
Necrotizing fasciitis	4 (100)	0	0
Streptococcal toxic shock syndrome	3 (75)	0	0
Death	1 (25)	0	0

^a Data missing for 1 suspected case.

^b Data missing for 2 suspected cases and 9 noncases.

days). The patient who was hospitalized for 77 days survived. Patients with confirmed GAS underwent 2 to 6 debridement surgical procedures (median, 3.5). Three of 4 patients, including the decedent, had at least 1 underlying comorbid condition, including obesity (body mass index [calculated as weight in kilograms divided by height in meters squared] >30).

Among 9 patients with suspected GAS infections, one was hospitalized and another was seen twice at an emergency department with a surgical site infection. The hospitalized patient, who was morbidly obese (body mass index >40), underwent an incision and drainage procedure to assess for deep soft-tissue infection and subsequently received a diagnosis of cellulitis. Specimens obtained at surgery were negative by bacterial culture.

We identified one instance of likely secondary GAS transmission. A household member came into direct contact with a confirmed case-patient's incision discharge when attempting to facilitate drainage. The household member, who had a minor preexisting fingertip wound, developed necrotizing fasciitis of the digit, necessitating amputation. Group A *Streptococcus* was cultured from a finger wound specimen, but the isolate was unavailable for typing.

Cases did not differ from noncases by age, sex, number of body parts treated, or facility (A or B) where the procedure was conducted. Of 55 patients interviewed who underwent liposuction, 45 (82%) were confident in their recollections. Multiple patients recalled that the surgical team did not wear masks (11 patients [24%]) or gowns (13 patients [29%]) during the procedure. One patient reported that the surgical team consumed food in the procedure room.

Health Care Worker Assessments and Screening for GAS Colonization

A single physician (physician X), not board certified in plastic surgery, performed liposuction on all patients with confirmed and suspected GAS. Of 4 physicians conducting liposuction procedures during the study period, physician X was the only physician who worked at both facilities, traveling with a Pennsylvania-based team to perform procedures at facility A in Maryland. Physician X, the 4 liposuction assistants from the traveling team, and all other staff at facility A were screened for GAS colonization. Three specimens from 2 personnel, physician X (throat) and a traveling surgical assistant (throat and anus), were culture positive for GAS.

The culture-positive team members reported using surgical gloves and masks during surgery but not during surgical marking, preoperative preparation, or postoperative care. Physician X reported a 5-day absence from work in August 2012, coinciding with the gap in cases during the week of August 19, 2012 (Figure). During this interval, the physician reported self-treating cellulitis of the hands with cephalexin. The surgical assistant, who had patient contact during preoperative, intraoperative, and postoperative duties, reported having had a sore throat sometime during July and August 2013.

Microbiological Characterization of GAS Isolates

Group A *Streptococcus* isolates for 3 of 4 confirmed cases and the isolates from the surgical team were available for molecu-

lar typing. All were identified as *emm* type 28/T-antigen type 28, with an identical antimicrobial susceptibility pattern demonstrating resistance to erythromycin, clindamycin, and tetracycline.

Site Visits

Assessment of facility A in Maryland identified visibly dirty equipment, no designation of clean and dirty areas for reprocessing equipment (including disinfection and sterilization), surgical scrub materials left open to the air, and no logs of autoclave use, maintenance, or performance checks. Multiple-dose medication vials were inadequately labeled, and expired products were present. Open packages of nonsterile surgical dressings used for liposuction were stored in high-traffic areas. Procedure-specific infection prevention policies and documentation of employee training in infection prevention measures were unavailable. Preoperative and postoperative patient evaluations were inconsistently conducted by a physician or licensed health care provider.

Assessment of facility B was also performed. It identified unlabeled multiple-dose medication vials, no autoclave maintenance or performance logs, no infection prevention policy manual, and no records of employee training in infection prevention.

Public Health Actions Taken

The liposuction team members associated with GAS infections were instructed to refrain from working until screening cultures were GAS negative. Colonized health care personnel were prescribed penicillin G benzathine and rifampin for 4 days per the CDC recommendations.³¹ Repeat cultures of colonized personnel on day 14 after antibiotic completion failed to recover GAS; these personnel were cleared to resume patient care.

Maryland state and local health officials required facility A to cease operations after the site visit, and the cosmetic surgery chain has elected not to reopen the facility. The PADOH recommended temporary suspension of liposuction at facility B until the facility developed and documented infection prevention policies specific for liposuction and all other procedures with the assistance of a certified infection preventionist. The PADOH also advised that at least 1 staff member should have infection control expertise or that routine access to infection prevention expertise should be available through contracted services.

Discussion

We are unaware of previous reports of invasive GAS outbreaks associated with liposuction. The outbreak we investigated was severe: 4 patients were hospitalized and 1 died. Our findings underscore the importance of improved oversight of the increasingly complex surgical procedures that are performed at outpatient facilities that are not subject to state or federal regulation.

Outbreak reports have described transmission of GAS from asymptomatic colonized health care personnel to surgical

patients.³⁻⁷ In addition to direct-contact transmission, sporadic transmission of GAS in surgical settings is thought to occur by droplet.^{3,5,32,33} In this outbreak, 2 surgical team members were colonized with GAS. In addition to asymptomatic oropharyngeal GAS colonization, the physician likely experienced a streptococcal hand infection at the time procedures were performed on 3 patients who later experienced severe invasive infections. Information from site visits and patient interviews indicated that routine infection prevention practices were deficient. One limitation of our investigation was the inability to definitively determine the cause of infection in suspected case patients. Also, it was impossible for us to review records from facility A and facility B for all patients who underwent liposuction; we relied on patient recollection about procedure and postprocedure experiences.

Liposuction is a major surgical procedure and carries risks that may be poorly understood by physicians and the public.³⁴ Rates of minor complications associated with tumescent liposuction (eg, palpable and visible irregularities, seroma formation, or localized infection) have been estimated at 0.6% to 22%, and major complication (eg, fat embolism, cutaneous necrosis, or severe infection) rates range from 0.14% to 0.38%.^{35,36} Liposuction involves dissection and removal of fat by repeated thrusts of an aspiration cannula, providing opportunities for GAS introduction into the subcutaneous space and generating tissue and vascular damage between skin and muscle fascia, conditions that can promote bacterial growth.²⁰ Patients who are obese (body mass index >30) might be at increased risk of infection and other complications when undergoing surgical procedures.³⁷ Careful patient selection (with a focus on body mass index and other underlying conditions) and surgical facility selection (eg, hospital vs outpatient setting) are important to liposuction safety.^{34,38}

Patients should consider the certification status or training of the physician performing their cosmetic surgery procedures. The American Board of Medical Specialties has approved the American Board of Plastic Surgery to certify plastic surgeons: at least 5 years of surgical training in a nationally accredited residency program are required for certification.³⁹ However, physicians need not be trained in plastic or general surgery to conduct cosmetic surgical procedures, including liposuction.⁴⁰ Nonresidency training options for cosmetic surgery range from lectures and workshops to comprehensive fellowships, with varying emphasis on infection prevention. The number of cosmetic surgery procedures conducted by physicians other than plastic surgeons has been increasing.^{20,40} For example, an analysis of liposuction procedure volumes in southern California found that otolaryngologists, dermatologists, and primary care physicians ranked second through fourth after plastic surgeons.⁴⁰

As noted in our investigation, liposuction and other cosmetic surgery procedures are often conducted at facilities not regulated by states or the federal government. This outbreak exemplifies why cosmetic surgery facilities should, at a mini-

mum, comply with basic infection prevention guidelines applicable to Centers for Medicare & Medicaid Services-certified ambulatory surgical centers and to outpatient settings more generally.^{27,41} To date, regulation of freestanding outpatient surgical facilities is largely dependent on owner-operators seeking and meeting Medicare certification requirements. Centers for Medicare & Medicaid Services-certified ambulatory surgical centers are eligible for Medicare reimbursement through facility and procedure fees. In return, they are subject to minimum health and safety standards, including periodic inspections and assessment of infection control procedures by state agencies, Centers for Medicare & Medicaid Services, or approved accrediting organizations.^{28,41} Cosmetic surgery procedures are often elective and not covered by Medicare or other health insurance. As such, these facilities might fall outside Centers for Medicare & Medicaid Services oversight, with regulation determined by variable state policies.⁴² The facilities we investigated operated in states where regulation was not required. The Pennsylvania facility did not qualify as a regulated ambulatory surgical facility because no procedures requiring constant medical postoperative monitoring were performed.⁴³ In Maryland, the facility was not regulated because it did not accept payment from third-party payers.⁴⁴ In May 2013, in response to this outbreak, the Maryland General Assembly passed legislation authorizing their secretary of health to adopt regulations for certain cosmetic surgery procedures considered to be high risk.⁴⁵⁻⁴⁷ Approaches to improving outpatient liposuction safety have also been made in other states.^{48,49}

Conclusions

The growing popularity of liposuction, as well as the diversity of settings and physicians offering this procedure, indicates an ongoing and possibly increasing potential for outbreaks similar to the one reported herein. Physicians should encourage patients inquiring about cosmetic procedures to select a surgeon fully trained in cosmetic surgery and operating out of an accredited outpatient surgical center or hospital.^{34,40} Physicians also should maintain vigilance for possible infections after cosmetic surgery, including suspicion of necrotizing fasciitis as a possible postoperative complication. Prompt reporting of health care-associated GAS infections and possible clusters to public health authorities can facilitate rapid investigation and implementation of necessary control measures; the CDC has published recommendations for the investigation and response to postpartum and postoperative GAS infections.³¹ Finally, the concerns raised in this study highlight the need to examine regulations for the oversight of facilities offering outpatient cosmetic surgical procedures. Maintenance of basic patient safety requires that appropriate infection control practices and other protections are implemented and monitored in these settings.

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Invited Commentary

The Gap in Patient Protection for Outpatient Cosmetic Surgery

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In September 2012, a 59-year-old woman died in the hospital shortly after undergoing tumescent liposuction at a medical spa for cosmetic surgery in suburban Maryland. As her sister reported, “We never expected her to die from something...that’s so simple.”¹



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Astute physicians reported her case to the Maryland Department of Health and Mental Hygiene, Baltimore,

prompting an investigation that identified 4 confirmed cases and 9 suspected cases of patients with severe invasive group A *Streptococcus* infections related to this outpatient facility and another owned by the same company in Pennsylvania. Each of the affected patients had surgery that was performed by a physician who was not board certified in plastic surgery and, as was later determined, was colonized with group A *Streptococcus* and likely experienced a Streptococcal hand cellulitis at the time procedures were performed on 3 patients. The technician working on each of the cases was also colonized with group A *Streptococcus* (both the surgeon and the technician harbored the identical genotype of the bacteria that had infected patients). Three other patients were hospitalized with necrotizing fasciitis. They required a median of 19 days in the hospital, with 2 to 6 surgical debridements per patient. This outbreak ended with the closure of the outpatient cosmetic surgery facility in Maryland and the temporary suspension of liposuction at the facility in Pennsylvania until infection prevention practices were improved.

In this issue of *JAMA Internal Medicine*, Beaudoin and colleagues² report on the public health investigation and re-

sponse to this outbreak of severe group A *Streptococcus* infections. Their findings highlight the risks to patients who have cosmetic surgery at outpatient facilities that are not subject to state or federal oversight and regulation, as was the case at the time in Maryland and Pennsylvania.

Medical spas are a cross between day spas and physician clinics. Insurance often does not cover services, which include elective botulinum toxin injections, laser skin treatments, facial peels, and more invasive procedures such as skin filler injections, breast implants, liposuction, and face-lifts.³ Such facilities are managed by all types of physicians, dentists, podiatrists, or even nonphysicians in some states. Aestheticians perform most services; they generally have completed a few hundred hours of training and have taken a test for professional licensing by the cosmetology board of the state in which they practice. Most states do not require medical spas to be licensed, and great variation exists in the quality of services provided.

The number of medical spas increased from fewer than 500 in 2003 to 1750 in 2011 in the United States.⁴ Procedures performed in such facilities usually cost less than when board-certified dermatologists or plastic surgeons perform them in traditional medical facilities. Often, the physicians who work at medical spas are not board certified; they may have no special training or may learn the trade with brief course work.⁵ The National Society of Cosmetic Physicians offers 2-day workshops in laser liposuction, breast augmentation, and abdominoplasty. After taking a workshop, obstetricians, family phy-