Infectious Complications From Body Piercings—A Narrative Review

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Abstract: Body piercings are common methods of self-expression and cultural identity and have existed for millennia. However, breaching the dermis and insertion of a foreign object entails risk, including infectious complications. Although serious complications are typically rare, especially in environments where proper piercing techniques and sanitation are practiced, the general public and healthcare professionals may be unaware of the risk for these complications. Serious complications may include tissue necrosis, endocarditis, and brain abscesses. Selection of a proper piercing locale and professional, and the use of personal hygiene practices and piercing site care can go a long way toward preventing infections. Avoidance of especially risky piercing sites or techniques may also be advisable.

Key Words: body piercing, body modification, ear piercing, infectious complication

(*Infect Dis Clin Pract* 2024;32: e1366)

ILLUSTRATIVE CASE

A 38-year-old man joined his teenage daughter for a shopping mall piercing appointment; his tongue was pierced with a metal post. Several hours later, glossal pain and swelling developed; this worsened over the next 8 hours. He had odynophagia and dysphonia; fever ensued. He presented acutely ill, febrile, tachycardic, and in distress due to severe tongue pain. The tongue was tender, red, edematous, and nearly obscured the piercing post. He had mild submental tenderness. Imaging did not show airway obstruction, edema of the hypopharynx, or tongue abscess. His white blood cell count was 18,000 with increased bands. He was admitted, the post was extracted, and ampicillin-sulbactam was administered. Admission blood cultures grew *S pyogene*s. He responded rapidly to therapy and was discharged after 4 days.

Breaching the dermis to secure various items such as rings, figurines, posts, and needles to body structures have been practiced for eons.[1] In North America, "body piercing" is increasingly adopted for aesthetics, "shock value," or perceived sexual benefits. The practice may reflect wholesome individual self-expression; it has also been perceived as a declaration of defiance, a mark of a subculture, or deviance in some contexts.[2–4] Many anatomical sites are pierced, including the face, torso, and genitalia.[5] These settings in which piercings are conducted may have inconsistent or inadequate application of infection prevention measures and are often loosely regulated.[6] Complications following body piercing include keloids, allergic reactions, dental damage, and scarring.[5,7] Infectious complications from this practice are based on estimates as patients may engage in piercing themselves or in unregulated settings and not see medical care for self-limited problems. Because body piercing remains popular among adolescents and young adults,[8] this reviews some of the medical literature related to significant infectious complications of body piercing.

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The authors have no funding or conflicts of interest to disclose.

Supplementary Materials: Not applicable.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

ISSN: 1056-9103

MATERIALS AND METHODS

Articles were retrieved using PubMed and Google Scholar search engines for the following terms or combination of terms: infection, infectious complications, body-, facial-, ear-, oral-, tongue-, nose-, navel-, breast-, genital-, facial-, and nipple piercing, body piercing regulation, infection prevention, and outcomes. There was no limit or timeframe placed on the publication date. International publications were included and publications in languages other than English were translated into English using the Google Translate service.

INFECTION BY ANATOMICAL SITE

Face

Auricular piercings are one of the most frequently pierced sites[9] and are divided into two categories: lobule, and cartilaginous or "high-ear" piercings. Cartilaginous piercing has a higher infection risk[10,11] and more severe complications.[7,12] The lobule, the site most often pierced, does not have underlying cartilage but is comprised of vascular fibro adipose tissue surrounded by skin. Piercings of the outer ear cartilage may be problematic since these regions are relatively avascular and in continuity with the cartilage of the external auditory canal. Cartilage relies on the perichondrium, the cell layer overlying cartilage, for vascularization. The increased infection risk associated with cartilage piercing may be related to the hypovascular nature of the tissue.[13]

Rates of ear-piercing infections have been examined. One study of 458 individuals noted an infection rate of 2.8%.[14] A survey of nurses showed, out of 1200 total piercings, only 1% were treated for infection.[10] A review by Sosin et al examined 29 articles on trans-cartilaginous ear piercing infections among patients who had symptoms for more than 5 days before seeking treatment and were more likely to be hospitalized (with a mean time from symptom onset to seeking care 6.25 days). Of the 66 pooled cases, physical findings were documented in 38 patients, of which purulence at the piercing site was obvious in 84%.

Many cases of postpiercing chondritis occur within 2–4 weeks after the inoculating event. Complications often occur during the summer months, perhaps reflecting a humid environment favoring the growth of organisms such as *Pseudomonas*.[15,16] Infection may be limited to mild cellulitis but can lead to diffuse swelling of the auricle, often sparing the lobe.[17] A systematic review found that scapha piercings were more likely to result in deformity than piercings of the helical rim. Infected cartilage may require extensive debridement and drainage,[11] intravenous antibiotics, and, in some cases, reconstructive surgery.[18–22] One report described five

patients with high-ear postpiercing infections requiring removal of damaged cartilage and insertion of a costal cartilage framework.[19] *Pseudomonas aeruginosa* was the most common pathogen infecting pierced ear cartilage and the most frequent cause of severe high-ear postpiercing infection requiring hospitalization.[13]

The oral cavity is one of the most favored for piercing, a site densely colonized and where infections secondary to piercings occur. Besides infection, intraoral piercing has also been associated with foreign body aspiration, airway obstruction, dental damage, and gingival disease. Martinello and Cooney note that the untraumatized tongue may be somewhat resistant to infection due to continuous bathing of saliva, high vascularity, secretion of antimicrobial proteins by oral epithelial cells, and a thick, keratinized outer layer.[23] A study of 50 patients with oral piercings found a majority of piercing sites healed without complications (74%), with only one case requiring physician involvement due to infection. Another series of 60 patients with oral piercings recorded 18 developed infections.[24] Of oral piercing injuries presented to United States emergency departments over 7 years (an estimated 24, 4459 injuries), 42% had infectious complications.[25] Oral piercings may alter the local microbiome by unknown mechanisms. Several studies have found an increase in pathogenic periodontal bacteria in patients with tongue piercings.[26–28] Tongue devices may foster a higher prevalence of several bacteria on the tongue surface, periodontal pocket, and/or cheek, including *Treponema denticola*, *Prevotella intermedia, Aggregatibater actinomycetemcomitans,* and *Porphyromonas gingivalis*.[26] One study examined piercing materials (surgical steel, titanium, polypropylene, and Teflon) and proclivity for biofilm by *Ekinella corrodens* and *Streptococcus oralis* using in vitro methods. Metals had the lowest rates of colonization. Another study examined the colonization of different piercings that had been worn by study subjects for 2 weeks showing greater bacteria counts on stainless steel studs compared to polytetrafluoroethylene or polypropylene piercings (67 of 80 species, $P < 0.01$). Though a small cohort, one study examined a group of 12 subjects with tongue piercing followed longitudinally.[28] Accumulation of debris or calculi in the piercing channel may also predispose to infection.[29] Some suggest acrylic piercings are preferable because they are less harmful to teeth and oral mucosa, although they may facilitate fungal infection.[27] For example, tongue piercing was found to be a risk factor for candida colonization ($P = 0.034$), with no difference in candida colonization found between piercer ornament wearers and nonwearers.[30] Candida infections have been associated with oral piercings, which is unsurprising given the oral cavity is frequently colonized by candida.[31] Although candida infections are often associated with immunocompromised patients or those using inhaled corticosteroids, cases of oral candidiasis in immunocompetent patients with oral piercings have been reported.[32]

Overall, facial infections are less common than ear infections.[33] Infectious complications from piercing the oral cavity range from simple abscesses to submental disease, Lemierre's syndrome,[34] and brain abscesses. Oral anatomy plays an important role in infectious complications, due to both the vascular supply of the oral cavity and its proximity to vital structures. The tongue is supplied primarily by the lingual artery, a branch of the external carotid artery, which drains to the internal jugular vein. This vasculature and adjacent lymphatics in the head and neck may allow spread to surrounding structures.[35] The spread of infection may compromise speech, as in the illustrative case above, and cause airway obstruction.[35] Dislodgement of the piercing ornament may also be problematic. In one case, a screw from a lip piercing ornament dislodged into the labial submucosa causing abscess formation.[36]

The facial zone from the supraorbital area to the lips is drained by the facial veins. The supratrochlear and supraorbital veins drain the orbit and adjacent territory. These repositories directly communicate with the cavernous sinus which may predispose to documented cavernous sinus thrombosis and intracranial infections.

Nasal colonization by *Staphylococcus* may place nasal piercers at a higher risk of infection from these pathogens. Up to 30% of human nares may be colonized by *S. aureus*,[37] with rates of methicillin-resistant *Staphylococcus aureus* (MRSA) as high as 11%[38] depending on the population studied. Other nasal colonizers include a variety of bacteria relevant to human diseases such as *Haemophilus influenzae*, *Morazella catarrhalis*, and *Streptococcus pneumoniae*.[39] Serious complications requiring hospitalization and surgery have been reported. Reports of infectious sequelae from eyebrow piercings are uncommon. Table 1 summarizes examples of severe outcomes associated with piercing of the face.

Torso and Below

Nipple piercings are uncommonly infected, perhaps related to the rich blood and lymphatic supply, especially in females. Conversely, the lymphatics may facilitate infection spread, to deeper tissues.[66,67] Both the nipple and mammary ducts contain endogenous flora and can include pathogenic taxa such as *Staphylococcus, Pseudomonas*, *Acinetobacter*, and *Enterobacteriaceae.*[68] Differences in bacterial population from breast tissue may vary across nationality[68] and between patients with or without breast diseases (such as breast cancer). Infection from the piercing sites may spread to breast implants.[69,70] In one case, a breast implant became infected 6 months after placement with piercing of the nipple; ultrasound confirmed inflammatory fluid collection around the device which resolved with 2 weeks of antibiotics.[69] Cases of *Mycobacterium fortuitum* infection after nipple piercing are documented.[71,72] The diagnosis of mycobacterial infection may be delayed since some clinicians fail to consider these taxa and many are slow-growing and require special media.[67] Consider *M. fortuitum* and other mycobacterial species if a nipple piercing infection fails to resolve after treatment for common pathogens such as *S. aureus*.[71]

As the umbilical remnant, pathogen inoculation at the navel can spread intra-abdominally. Skin irritation due to under or overcleaning, as well as irritation from clothing, friction between skin folds, and increased skin moisture may predispose to infection.[73] The microbiome of the navel may influence infections. A study of 60 human belly button swabs found the most common bacteria to include staphylococci, corynebacterial, actinobacteria, and clostridial, with a total of 2368 species identified.[74] Another study noted high concentrations of opportunistic pathogens such as *Pseudomonas*, which were found in 21 of 22 samples.[75] Studies have also found abdominal and gastrointestinal organisms present in the navel.[75,76] Skin folds and crevices of the navel/belly button, as well as the collection of sweat, may influence this. We are aware of no studies on the effect of piercing on the navel microbiome. Serious complications can occur from navel piercings, including pyogenic liver abscess,[77] endocarditis,[78–81] and toxic shock syndrome.[82]

Male genital piercing practices have many variants including the insertion of a metal ring through the urethral opening and exit from the ventral phallic shaft ("Prince Albert Ring"). Besides skin commensals as pathogens, the acquisition of *Neisseria gonorrhea*, *Chlamydia trachomatous*, and human papillomavirus have been associated with male genital piercing.[83,84] One study paradoxically observed no chlamydia or gonorrhea infections in men with genital piercings despite sexual partners with these infections. Authors theorized the slow release of metal ions from piercing may be protective in the male urethra. The study population was small

TABLE 1. Notable Infectious Complications Associated With Piercing of the Oral Cavity and Head

Body Site	Syndrome	Microbiology	Outcome	Reference
Tongue	Ludwig's angina	-	Recovery	Perkins, 1997[40]
Tongue	Cerebellar abscess	*Streptococcus viridans, Peptostreptococcus, Actinomyces, Eiknella corrodens*	Craniotomy, recovery	Martinello, 2003[23]
Tongue	Multifocal brain abscess	*Streptococcus*	Death	Herskovitz, 2009[41]
Tongue	Tetanus	*Clostridium tetani*	Neurologic sequelae	Dyce, 2000[42]
Tongue	Acute glossitis	-	Hospital, recovery	Keogh, 2001[43]
Tongue	Endocarditis	*Neisseria mucosa*	Mitral valve replacement	Tronel, 2001[44]
Tongue	Sigmoid sinus thrombosis, pulmonary abscesses	-	Hospital, recovery	Nicholas, 2007[45]
Oral	Endocarditis	*Gemella morbillorum*	Recovery, mitral valve replacement	Carano, 2010[46]
Tongue	Endocarditis	*Strep viridans*	Aortic valve replacement (Ross procedure)	Lick, 2005[47]
Ear cartilage	Pinnae abscess, chondritis	*Pseudomonas aeruginosa*	Hospital, defect from excision	Staley, 1997[17]
Ear cartilage	Chondritis	*Pseudomonas aeruginosa*	Resolved	Turkeltaub 1990[48]
Ear	Post-streptococcus glomerulonephritis	*Streptococcus pyogenes*	Recovery	Ahmed, 1984[49]
Ear	Toxic shock syndrome	*S. aureus*	Recovery	McCarthy, 1988[50]
Ear	Endocarditis	*S. viridans*	Repair of VSD, recovery	Battin, 1991[51]
Ear	Bacteremia	*S. aureus*	Iliac osteomyelitis	Lovejoy, 1970[52]
Ear	Primary tuberculosis	*M. tuberculosis*	Recovery	Morgan, 1952[53]
Ear	Perichondritis	-	Recovery	Fernandez, 2008[54]
Ear	Necrotizing soft tissue infection	*S. aureus, P. aeruginosa*	Recovery	Nnadozie, 2020[55]
Ear	Ear plaque	*Chrysosporium*	Recovery	Suchonwanit, 2015[56]
Ear	Cartilage necrosis	*P. aeruginosa*	Debridement, recovery	Sandu, 2007[57]
Ear	Pyogenic spondylitis	*S. aureus*	Recovery	Sewnath, 2007[58]
Nose	Cavernous sinus thrombosis	-	Hospitalization, recovery	Torres, 2020[59]
Nose	Endocarditis	*S. aureus*	Mitral Insufficiency	Ramage, 1997[60]
Nose	Endocarditis, brain abscesses	*S. aureus*	Multiple embolisms and organ damage, valve replacement	Guliana, 2010[61]
Eyebrow	Inflammatory skin nodule	*M. flavescens*	Recovery	Ferringer, 2008[62]
Eyebrow	Preseptal cellulitis	*S. epidermidis*	Hospitalization, surgical debridement	Contreras-Ruiz, 2015[63]
Eyebrow	Inflammatory skin nodule	-	Surgical removal, recovery	Horle, 2002[64]
Eyebrow	Diplopia, ocular muscle deficit	-	Recovery	Carelli, 2008[65]

(n = 7), nor was the effect observed in female patients.[85] Complications of genital piercing include fistulization of the glans penis.[86] In one instance, myiasis of the penis secondary to penile piercing infections, followed by wound infection at a site open to flies.[87] We did not note any reports of infectious complications of vulval or clitoral piercings. A representation of the types and outcomes following piercings below the head are summarized in Table 2.

SYSTEMIC INFECTIOUS COMPLICATIONS

Numerous instances of bacteremia temporally associated with body piercing have been described. The incidence of this is unknown because the relationship between piercing and a febrile syndrome with bacteremia may not be captured in the clinical history. However, there are several important systemic pathologies that clinicians should be aware of in relation to body piercing infections.

Endocarditis

Infective endocarditis is an uncommon but dangerous outcome linked to body piercing. A review of this complication by Armstrong et al suggested the risk may be greater in persons with underlying congenital heart disease (CHD), not surprising since this group is at risk for endocarditis in general.[73] "High-ear" (cartilage), tongue, and navel piercing were the most common portal of entry. In these cases, the infection typically developed at the site of the defect, and surgical intervention was often needed.[73] Other piercings sites have been implicated including the lip, nipple, and genitalia.[99] Infections occurred 1 week to 3 months after piercing, and patients ranged from 12 to 30 years. No patients had a recent history of intravenous drug use or HIV infection. Of note, many cases of postpiercing endocarditis were found to occur in patients with CHD. Many have recommended that patients with CHD either avoid body piercings altogether or receive prophylactic antibiotics prior to piercing.[73,100] It has been noted that, as is true of infectious endocarditis in general, most cases of body piercing associated with endocarditis are caused by *Staphylococci* and *Streptococci*.[61]

Brain Abscesses

Brain abscesses are another rare but serious complication from body piercings. Cases exist documenting a case of brain

TABLE 2. Notable Infectious Complications Associated With Body Piercing Below the Head

Body Site	Syndrome	Microbiology	Outcome	Reference
Umbilicus	Periumbilical nodule	*M. chelonae*	Excision, recovery	Ferringer 2008[62]
Umbilicus	Mesenteric infarction	-	Death	Ranga, 2011[88]
Umbilicus	Endocarditis, midbrain infarct	-	Recovery	Ferguson, 2006[89]
Nipples	Mastitis	*M. abscessus*	Mass resection, recovery	Trupiano, 2001[90]
Nipples	Endocarditis	*S. epidermidis*	Aortic valve replacement	Oschsenfahrt, 2001[91]
Nipples	Toxic shock syndrome	*Staphylococcus aureus*	Death	Bader, 2006[92]
Breast	Mastitis	*M fortuitum*	Surgical excision, recovery	Lewis 2001[93]
Penis	Myiasis	-	Surgical debridement	Freitas, 2018[87]
Penis	Toxic shock syndrome, Fournier's gangrene	*Strep pyogenes*	Hospital, recovery	Ekelius, 2004[94]
Penis (genital ring)	*Gonorrhea, Chlamydia ballantitis*	*N. gonorrhoeae*	Recovery	Hounsfield, 2008[83]
Penis	Pyelonephritis/bacteremia	*E coli*	Recovery	McCordle 2020[95]
Breast	Mastitis, abscess	*N. gonorrhoeae*	Recovery	Ceniceros, 2019[96]
Nipple	Abscess, mastitis	-	Recovery	Kapsimalakou, 2010[66]
Nipple	Abscess	*M. fortuitum*	Recovery	Siddique, 2020[97]
Naval	Endocarditis in patient with muscular VSD	*S. viridans*	Recovery	Barkan, 2007[80]
Breast	Abscess	*M. fortuitum*	Debridement, recovery	Abbass, 2014[71]
Nipple	Hardware infection (breast implant)	*S. epidermidis*	Recovery	Cornelissen, 2017[70]
Naval	Endocarditis	*S. aureus*	Mitral valve repair [limited info on recovery]	Raja, 2004[98]

abscess 4 weeks after a tongue piercing in a female with a history of intravenous drug use.[23] Another describes 13 ring-enhancing cerebral abscesses growing *Streptococcus intermedius* in an individual 2 weeks after a tongue piercing resulting in sepsis and eventual fatality.[41] In another case, a cerebellar abscess formed in a 22-year-old woman 1 month after a tongue piercing growing multiple oral flora pathogens.[23] Though rare, these represent some of the most serious infectious complications of body piercings.

ORGANISMS

Viruses

Blood-borne pathogen transmission during body piercing may be a risk factor for the blood-borne hepatitis viruses as demonstrated in several population studies.[101] although the data are not definitive. Multiple cases of hepatitis B (HBV) and C (HCV) transmission from body piercing are documented,[102–104] and several studies show an association between body piercing and HBV[105–107] and HCV[106,108] risk. One report found that nose, but not ear, piercing was associated with HBV and HCV risk.[106] All of these studies were performed in regions with moderate to high HBV prevalence.[109] A study of body piercing in India, despite a high HBV prevalence, was not a significant risk factor for infection[110] while 40 studies found the risk of HBV and HCV transmission relative to body piercing to be 1.80 (95% confidence interval [CI]: 1.18, 2.75) and 1.83 (95% CI: 1.27, 2.64).[111] A meta-analysis found no increased risk of HCV when piercings were performed in professional settings,[112] which comports with a study of Texas college students showing no association between body piercing and HBV and HCV transmission.[113] Hepatitis virus transmission risk may be related to the setting where the piercing was performed, the adherence to best practices, and possibly the local prevalence of hepatitis.

Body piercing is not considered to be a risk factor for HIV transmission.[114,115] While difficult to document with certainty, there are instances in which HIV infection was associated with body piercing[116] and acupuncture.[117] Pugatch et al report a case of possible HIV transmission in a patient who received multiple piercings at multiple body sites during the likely period of seroconversion.[116] However, it is highly unlikely that HIV will be transmitted via body piercing in professional settings where a trained practitioner performs the piercing while adhering to best practices for infection prevention.

Bacteria

Pseudomonas, as described previously, is a frequently implicated pathogen in piercing-associated infections. Part of the reason for this may be an observer bias phenomenon because infections from drug-susceptible infections due to *Streptococci* or *Staphylococci*, for example, may respond to common oral antibiotics and not lead to reporting. *Pseudomonas* is resistant to oral beta-lactam drugs and unlikely to respond to first-line empiric antibiotics given to outpatients with skin and skin structure infections. It thus may be more frequently mentioned in clinical reports of refractory infection. Because *Pseudomonas* thrives in moist environments where piercing instruments may be stored as well as biofilms on pierced devices and around devitalized tissue, wound inoculation with this organism is not surprising.[118]

Staphylococci, particularly *S. aureus*, are among the most common commensals of the dermal microbiome. Substantial proportions of the population are colonized with *S. aureus* both in the nares, axillae, and genital areas. *S. aureus*, more than most other *Staphylococci*, produces a variety of enzymes and toxins facilitating tissue invasion, and destruction capable of inciting a purulent and acute host inflammatory response.[119]

Mycobacteria and Others

Several cases of cutaneous mycobacterial infections associated with piercings have been documented,[120] including infections from *Mycobacterium flavescen*s and *Mycobacterium chelonae*. Diagnosis is almost impossible without a biopsy for

histopathology and culture of the lesions. Treatment frequently entails the excision of infected tissue and multimonth courses of antimicrobials.[62,121,122]

In addition to more commonly implicated organisms for postpiercing infections less common pathogens include *lactobacillus* (ear),[123] *Veronaea botryose* (ear),[124] *Haemophilus parainfluenzae endocarditis* (tongue),[125] *Haemophilus aphrophilus* (tongue),[126] *Neisseria mucosa* (tongue),[44] *Gordonia-terrae* (nipple),[127] P*revotella intermedia* and *Peptostreptococcus anaerobius* (nipple),[128] *Peptostreptococcus micros* and P*revotella melaninogencia* (nasal),[128] as well as *Bacteroides fragilis* and *Enterococcus faecalis* (umbilical).[128] Some pathogens are drug-resistant including MRSA,[129] and imipenem-resistant *P. aeruginosa* (ear).[130] Cases of tetanus-related piercings infections have also been reported.[42,131]

MANAGEMENT PRINCIPLES

Body piercing complications can be evaluated from several vantage points. First, the site of the infection and body geography may not only implicate some pathogen possibilities, based on regional microbiome, over others but may warrant earlier use of surgical options and broad-spectrum antimicrobials. For example, severe eye-threatening infection of the periorbital region or the face may pose greater hazards and risks than infections manifesting at the nipple. Second, the acuity and severity of the infection, as in other infectious disease scenarios, may drive triage decisions related to inpatient versus outpatient management. Lastly, the duration of the infection, prior treatments tried and failed, and host vulnerability may determine the need to consider elements such as "source control," surgical debridement, the need for biopsy and histopathology, or the use of broad-spectrum and novel antimicrobials (Table 3).

Regional infections at the site of the skin breach including local abscesses and cellulitis can often be managed in an ambulatory setting. Typical symptoms are redness, swelling, pain, heat, erosions, ulcers, papules, and pustules, which may spontaneously drain. Because the most common pathogens are skin commensals, including *Staphylococci* and *Streptococci*, oral beta-lactam agents may be appropriate empiric therapy. However, special considerations should be made for cartilaginous infections. As mentioned, *Pseudomonas* has been reported in cartilage piercings, and as such, management with fluoroquinolone antibiotics may be helpful.[12] A study of transcartilaginous piercing infections noted that only 20.7% of initial antibiotics covered for *Pseudomonas*, despite the fact that *Pseudomonas* comprises the majority of these infections (87.2%).[13] These therapeutic options may be less desirable for infections occurring in pediatric patients, for whom fluoroquinolones are typically not recommended. However, a systematic review found that fluoroquinolone use in pediatric patients found the risk of musculoskeletal adverse events to be 1.6% (95% CI 0.9%–2.6%) with 50% of these being arthralgia and 19.0% being a tendon or joint disorder.[132] Because of this, some authors suggest that a short course of ciprofloxacin in the pediatric population may be safe.[12] Additionally, because the rate of quinolone-resistant *Pseudomonas* is substantial, cautious reliance on this class for severe infections due to *Pseudomonas* is in order. Empiric therapy can be directed by anatomic colonization patterns of human commensals and prior antibiotic exposure. In the perineum, oral, and genital zone, therapy directed against anaerobes can be considered. Triage is based on acuity and extent of the infection, host immune status, vulnerability of adjacent anatomy, and presence of abscesses or necrosis requiring debridement. In some instances, such as dermal implants, the piercing may require blunt dissection or a surgical consult to be removed.[133] Patients with signs of sepsis or imminent threats, such as airway obstruction or fasciitis, warrant relevant imaging and surgical consultation. Prompt treatment improves outcomes.[13]

Removal of the device or foreign body and sending for culture along with wound samples can improve the chances of pathogen recovery. Following drainage of abscesses and debridement of devitalized tissue, first-line therapy will include agents active against the commensal flora. In the perineum and genital zone, therapy directed against *Enterobacteriaceae* should be considered. Cartilage infection should be treated promptly; one study observed that a delay greater than 5 days was associated with poorer outcomes.[13] The piercing canal can be maintained while the infection resolves by using a small catheter or similar material to keep the site open.[133,134] Mild infections may be treated with topical antibiotics. In some instances, such as dermal implants, the piercing may require blunt dissection or a surgical consult to be removed.[133]

Severe, disseminated, metastasizing infections along with those which fail to respond to first-line treatments will hopefully be recognized quickly. This category of infectious complications may be related to high inoculum, high virulence organisms, inherent host vulnerability (eg, diabetes), as well as antibiotic-resistant organisms. Unusual pathogens such as fungi, *Nocardia*, and atypical mycobacteria may also play a role here. For this reason, it is crucial to send fluid and tissue, if available, for appropriate microbiological studies including acid-fast and fungal stains with cultures. Histopathology can be especially helpful because some organisms may grow poorly if at all on routine media or, if they do, may take weeks to incubate. *Actinomyces*, for example, is a recognized pathogen in wound infections but may be fastidious requiring strict anaerobic conditions for growth. Clinical specimens may never grow *Actinomyces* but their characteristic morphology may suggest this pathogen by histopathologic stains. The presence of granulomas may suggest certain pathogens even if none are isolated on culture. Patients with signs of sepsis or imminent threats,

TABLE 3. Summary of Body Piercing Management Principles

Clinical Feature if Affirmative:	Management Priority	Comment
Sepsis or necrotizing fasciitis	Blood cultures, surgical evaluation, hospitalization	Debridement with tissue cultures may be required
Auricular Piercing	Include therapy targeting *Pseudomonas*	Some infections may be due to unusual organisms such as atypical mycobacteria
Oral piercing	Monitor for airway compromise and include therapy targeting oral anaerobes	Severe glossitis can lead to upper airway obstruction
Acute purulent wound site infections	Include coverage for *S. aureus*/MRSA	Staphylococcus is a common skin/soft tissue pathogen
Genital infections	Consider screening for sexually transmitted infections	
Assess immunization status	*C. tetani* is a potential but not common pathogen	Wound infection may be opportunity to review preventative health measures.

such as airway obstruction, warrant relevant imaging and surgical consultation. Empiric antibiotics for the patient with systemic inflammatory response syndrome or sepsis are selected based on standard sepsis guidelines incorporating local antibiogram information along with the body region affected.

PREVENTION

Preventions of body piercings infections involves avoiding homemade or administered piercing, such as using sewing needles,[135] and having piercings instead performed by a professional. As such, regulation of professional piercing practices comprises the majority of prevention focus. Laws governing body piercing practice vary. In the United States, the law varies between states, with most states prohibiting the tattooing or piercing of minors, or doing so without written consent.[136] Some states also set requirements for studio cleanliness and the general practice of piercing and tattooing.[136] There appears to be a trend for increased regulatory control of this practice in recent years. Many states require practitioners to hold a license, which usually requires the completion of an apprenticeship or career school program, blood-borne pathogens certifications, and a competency exam. However, many of these requirements do not apply to those working at ear-piercing kiosks.[137] The rationale may be that practitioners at these sites perform far less complicated piercing at a single anatomical site.[138] Nevertheless, as observed here, serious complications can arise from ear lobe piercings. Some individuals engage in self-piercing, which is likely performed with such "instruments" as safety pins, sewing needles, and home piercing guns.[135] Reports of infections resulting from self-piercing have been reported.[49]

Training and competence of piercing professionals are crucial to preventing piercing infections. However, some studies have shown a lack of knowledge about proper infection and adherence to proper infection control practices.[139–141] A 2003 study in Australia found that a low proportion of tattoo and body piercing shop managers gave correct answers regarding disinfection (26.9%) and sterilization (53.8%). Some practitioners had a high rate of compliance (such as using clean equipment and disposing of sharps) while others had a lower rate (eg, wearing disposable gloves for all skin procedures).[139] The National Environmental Health Association has recommended that piercing gun use be limited to ear lobes and that facilities that use piercing guns be subject to similar regulations as body piercing facilities.[137] Some states, including Ohio, Oklahoma, and Massachusetts, restrict the use of piercing guns to the ear lobe.[137] The American Association of Professional Piercers has banned its members from using reusable ear piercing guns for any type of piercing procedure, citing tissue damage, difficulty sterilizing the guns, design of gun studs being inappropriate for ear piercing, and common misuse.[142] The National Environmental Health Association recommends limiting the use of ear-piercing guns for ear-lobe piercings.[137]

Receiving professional piercing does not eliminate risk or guarantee that best practices will be followed. An outbreak of *Pseudomonas* ear cartilage infections occurred at a piercing salon where there was improper use of piercings guns and improper sanitization (such as repeated refilling of a single-use disinfectant bottle and spraying an already sterilized piercing gun with this disinfectant).[11] Another *Pseudomonas* outbreak occurred due to a combination of contaminated water pipes, a more invasive piercing procedure ("scaffold" piercing), and a new piercing practitioner.[143]

Piercing techniques and equipment are also important, with the majority of controversy and investigation surrounding the use of piercing guns. Piercings guns are typically spring-loaded, handheld devices used to puncture the skin and create a canal used to insert piercing jewelry. Piercing guns have been assumed to produce greater trauma and complications to ear skin and cartilage due to the use of dull piercing studs (producing blunt trauma), insufficient force (necessitating repiercing or manual forcing of the stud through tissue), insufficient stud length, and predilection for misuse.[142] However, a cadaveric pathology study comparing two piercing guns, a hand force system, and a piercing needle method found no difference in injury.[144] Sterilization of piercing guns can be difficult to clean due to plastic construction and may harbor blood and other tissue that has been ejected back into the gun after piercing. Alternative piercing methods have been proposed with hopes of reducing trauma and infection, including a diode laser[145] and carbon dioxide laser.[146] A study comparing carbon dioxide laser piercing and spring-loaded piercing guns found no infectious complications, although the study size was small (n = 14).[146] Improper sterilization of other equipment can also play a role. Indeed, several auricular pseudomonas infections have been linked to improper antisepsis with benzalkonium chloride.[147] It has been recommended that benzalkonium chloride be avoided in piercing sanitization.[148] Isopropyl alcohol or iodine are recommended antiseptic solutions, although isopropyl alcohol is ineffective against spores and iodine may be irritating to tissue.[148]

Previously, some healthcare professionals have supported antibiotic prophylaxis for patients receiving body piercing with CHD.[149–152] Although previous recommendations by the American Heart Association[153] were interpreted to include antibiotic prophylaxis for body piercings,[154,155] antibiotic prophylaxis for endocarditis prevention in body piercing is not currently recommended by this organization. This contrasts with recommendations for dental procedures in those with certain conditions, such as prosthetic heart valves or a history of endocarditis, where antibiotics prophylaxis is recommended.[156] The reasons for this recommendation regarding piercings might be due to the variety of sites and microbial flora for piercings sites, and the greater frequency of dental cleanings, or procedures among the general population compared to piercings. Nevertheless, some clinicians continue to recommend prophylaxis for those who are at high risk for endocarditis.[157] Certain situations may rely on the clinician's acumen.

Proper wound care postpiercing has been recommended to reduce infection such as cleaning them with alcohol and spinning the piercing periodically to keep the piercing patent.[158] Isopropyl alcohol or iodine is recommended antiseptic solutions, although isopropyl alcohol is ineffective against spores. For oral piercings, rinsing with oral cleansers such as a nonprescription mouthwash is recommended, although evidence for this is limited.[7] Benzalkonium chloride should be avoided in piercing sanitization.[148] Other methods have been proposed to reduce postpiercing infections. For example, a drug-eluting bioabsorbable scaffold was developed to cover piercing studs and reduce infection postpiercing. In their study, the authors used a mupirocin eluting scaffold that show effectiveness against *S. aureus in vitro*.[159] One outbreak of auricular pseudomonas infections was attributed in part to contaminated aftercare solutions containing benzalkonium chloride that was mixed onsite at the piercing salon and then given to customers to apply at home.[160]

The importance of removing jewelry as a part of infection management has been discussed. Patients may desire immediate reinsertion of jewelry postoperatively out of concern that the piercing site will close up. One study looked at the reinsertion of umbilical piercings postlaparoscopic procedure. Although the sample size was small (n = 21), the authors noticed no complications with the reinsertion of an umbilical piercing postoperatively when disinfection of the piercing and hand hygiene were used for reinsertion and when reinsertion was delayed until the skin for an adjacent umbilical port entry site had closed (2 or more days) and a physician had given approval. For patients concerned about piercing site closure, a sterile spacer was temporarily placed in

the piercing site.[161] A report of 5 adolescent female patients describes a similar technique with no evidence of infection.[162] Tsirikos and Subramanian describe a case of bacteremia and toxic shock believed to be due to the reinsertion of body piercing at multiple sites immediately postoperatively.[163] To our knowledge, guidelines regarding the reinsertion of piercings in a postoperative setting have not been given.

Reviews indicate patients, mostly adolescent and young adult females, typically avoid seeking medical attention until they have had problems for over a week, and these delays are linked to a greater likelihood of hospitalization.[13] A survey of young adults regarding the risks of piercing and tattooing found that while a majority knew the risk, some felt that piercings and tattoos either could not transmit infectious diseases (3.0%) or were unsure (6.8%). A larger percentage felt that places and instruments for piercing and tattooing were always safe (7.1%) or were unsure (10.6%).[164] A survey of secondary students in Italy found what the authors considered to be reasonable knowledge about infectious diseases (54.4%) and hygienic norms (72.3%) in regard to body art.[165] Most of these studies were conducted among adolescents suggesting the need for education regarding complications of body piercings in this demographic. One study enrolled 70 young adult females, the majority of which already had piercings (60/70, 85.7%), and provided education regarding body piercing practices. Posteducation analysis found that 68.6% (48/70) would have made different choices regarding piercings and 65.7% (46/70) said they would not consider piercing in the future (it is unclear how many participants intended to receive piercings prior to intervention).[166] Some of this may be related to the location where piercings were received, as 38.6% had received piercing at a mall kiosk or store (27/70) and 2.9% (2/70) at a friend's house. Indeed, individuals may be unaware of the risks of body piercing.[167–172] Clinicians can therefore play a valuable role in helping patients to make informed decisions regarding piercings and to adhere to best practices regarding piercing administration and care.

CONCLUSION

Piercings have been and continue to be a popular form of fashion and self-expression. While great improvements have been made in providing cleaner and safer piercings, the act of breaking the skin and the presence of a foreign object will always come with some risk. While these risks are most often related to piercing site discomfort and mild site infections, clinicians should be aware of the rare but severe complications that can arise from piercings. Patients who are planning to receive piercings should be counseled on how to maintain piercing site cleanliness, as well as be aware that certain anatomical sites may be associated with more complications or specific pathologies. Physicians who treat patients with infections should be aware that piercing can not only be a source of local but also systemic infections. Furthermore, they should recognize that in rare cases, unique or especially virulent organisms may be involved and that consultation with infectious disease or surgical specialists may be required. Finally, we hope that a greater awareness of piercing infections and their complications will lead to better outcomes for patients with these infections.

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