The Laryngoscope

Systematic Review

Transcartilaginous Ear Piercing and Infectious Complications: A Systematic Review and Critical Analysis of Outcomes

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Objectives/Hypothesis: The purpose of this systematic review was to critically analyze infectious complications and treatment following transcartilaginous ear piercing.

Data Sources: MEDLINE Pubmed database.

Review Methods: A MEDLINE PubMed database search using free text, including "ear chondritis," "ear perichondritis," "ear cartilage piercing," and "auricle piercing," yielded 483 titles. Based on set inclusion and exclusion criteria, the titles, abstracts, and full text articles were reviewed for inclusion and underwent data extraction. Pooled outcomes are reported.

Results: A total of 29 articles met inclusion criteria, including 66 patients. The mean age of the patients was 18.7 $\pm$ 7.6 years (range: 11–49), 87.5% female. Ear deformity was more likely to occur following postpiercing perichondritis of the scapha 100% versus the helix 43% ($P = 0.003$). Mean duration of symptoms prior to patients seeking medical attention was 6.1 $\pm$ 4.1 days. Greater than 5 days of symptoms prior to seeking treatment was significantly more likely to result in hospitalization. *Pseudomonas aeruginosa* accounted for 87.2% infections. Of the patients with *Pseudomonas*, 92.3% were hospitalized versus 75% of the patients infected with *Staphylococcus aureus*. Initial oral antibiotics prescribed did not target the cultured bacterium in 53.3% of cases; of these, 87.5% were hospitalized.

Conclusions: Transcartilaginous postpiercing infection may lead to ear deformity and hospitalization. Patients (customers) and practitioners must be aware of optimal treatment strategies to minimize associated morbidity. Scapha piercing and delay in presentation are associated with poorer outcomes. *Pseudomonas* is the most common bacterial infection. Initial antibiotic selection must be optimized accordingly.

Key Words: Cartilage, perichondritis, chondritis, ear, auricle, pinna, piercing.

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INTRODUCTION

Transcartilaginous ear piercing has become increasingly popular among adolescents in the last couple of decades.[1] The anatomical location of high ear piercing is commonly localized to the helix, scapha, or antihelix of the auricle. Piercings are frequently performed in substerile conditions, with inadequate patient counseling specifically pertaining to postpiercing care and potential complications. Violation of the skin and cartilage introduces the potential for infection, inflammation, and fluid accumulation, which may exacerbate an already tenuous blood supply to the cartilage.[2] The consequences of ear chondritis, perichondritis, abscess, or cellulitis may ultimately result in severe ear deformity and impaired acoustic funneling of the external ear.[3] Although earlobe piercing is considered to be a safe and routine procedure, transcartilaginous piercings pose an increased risk to the patient.

The incidence of infectious complications secondary to high ear piercing has recently increased.[4] Early recognition and proper treatment by the initial evaluating practitioner may prevent the progression to severe ear deformity. Patients may be initially evaluated by a multitude of disciplines, including a primary care physician, otolaryngologist, plastic surgeon, general surgeon, or an infectious disease specialist. However, there are a lack of standardized guidelines in the management of ear perichondritis following transcartilaginous piercing, and treatment strategies vary.[5]

The consequences of delayed intervention, improper choice of antibiotics, and multiple drainage procedures may result in systemic infection, antibiotic resistance, and cartilaginous collapse. Ultimately, this increases a financial and emotional burden to the patient during multiple outpatient visits, inpatient hospitalization, and multiple procedures, potentially requiring a future

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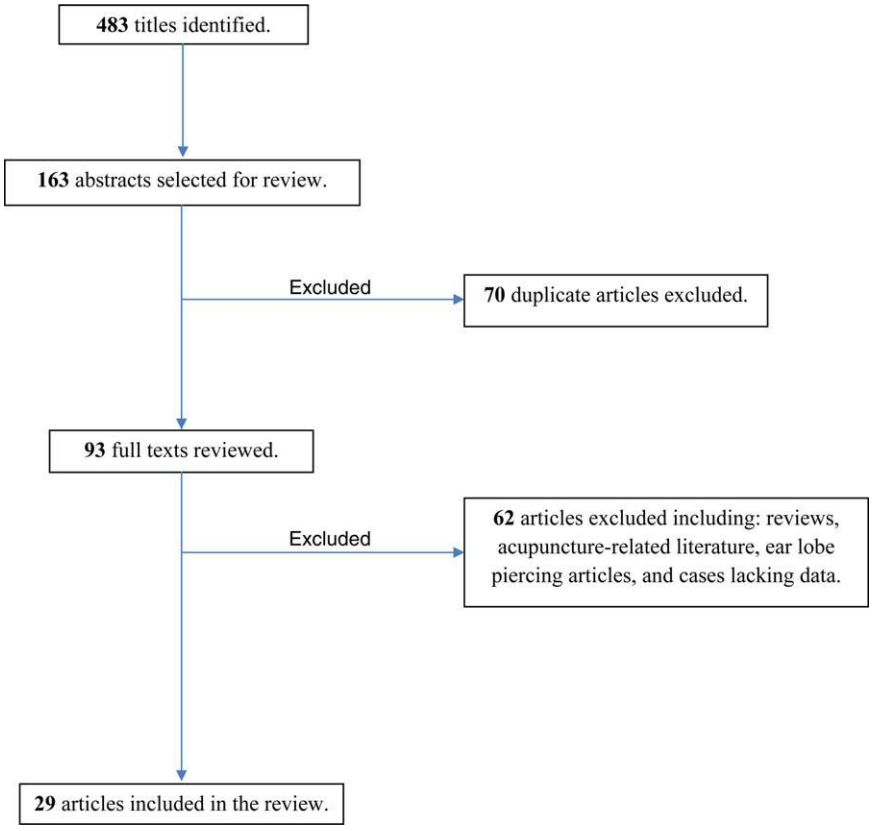

Fig. 1. Flowchart depicting the selection process for inclusion and exclusion of articles in this systematic review.

reconstructive procedure. Although a plethora of case reports describe infectious complications following transcartilaginous ear piercing (level IV evidence),[4] there is an absence of data investigating pathogenic etiology, anatomical location of defects, selection of antibiotic, surgical intervention, treatment outcomes, rates of deformity, and pursuit of reconstructive surgery.[5–7] Therefore, the purpose of this study was to systematically review the literature to critically analyze available data pertaining to infectious complications following transcartilaginous ear piercing.

MATERIALS AND METHODS

A systematic search of the English literature published in the MEDLINE PubMed database was performed based upon Preferred Reporting Items for Systematic Reviews and Meta-Analyses[8] guidelines to identity all relevant articles. Free-text search terms "ear chondritis," "ear perichondritis," "ear cartilage piercing," and "auricle piercing" were used to identify 483 titles. Titles were reviewed to identify relevant articles, yielding 163 abstracts for review, of which 70 duplicate articles were excluded. The remaining 93 full-text manuscripts were reviewed for case reports or case series that involved infectious complications following ear piercing. Review articles, acupuncture-related literature, ear lobe piercing, and cases lacking data were excluded. Articles meeting inclusion criteria underwent data extraction, including patient age, sex, symptom duration, time prior to consulting with a physician, presence of purulent drainage, antibiotic course (prior to hospitalization and during hospitalization), microbiology cultures, comorbidities, piercing location, and development of subsequent deformities requiring reconstructive surgery.

RESULTS

A total of 29 articles[1,5,6,9–34] met inclusion criteria for this systematic review (Fig. 1), and 66 patients were included in the pooled analysis (Table I). Of the 29 included studies, 31% were completed in the United States. The remaining studies were completed in other countries, reflecting a substantial representation of the available international literature (Fig. 2). Articles spanned from 1972 to 2014, with 79.3% of the studies completed after 1990 (Fig. 3). The mean age of the patients was 18.7 ± 7.6 years (range 39). Patient sex was reported in 56 patients (87.5% female; 12.0% male.)

Overall, mean symptom duration was 26.0 ± 29 days, and the median was 15 days (range: 2–120 days; an outlier of 1,450 days was excluded from the analysis). Many studies (n = 26) reported symptom duration prior to patients seeking medical attention.[1,5,9–32] The mean duration of symptoms prior to patients seeking medical attention was 6.2 ± 5 days, and the median was 6 days (range: 2–17.5 days). This excludes one patient outlier,[5] who reported symptoms lasting 120 days prior to receiving medical attention. There was no correlation between symptom duration prior to receiving medical attention and the rate of drain placement, but patients with greater than 5 days of symptoms prior to seeking treatment were

TABLE I.
Summary of Included Studies and Patients.

Author	Year	n	Age	Sex	Ears	Single or Multiple Piercings	Symptom Duration Prior to Physician Evaluation	Total Symptom Duration (days)	Hospitalized	Intravenous Antibiotics	Total Antibiotic Duration (days)	Cultured Bacteria	Piercing Location	Deformity	Reconstruction
Perry et al.[1]	2014	1	17	F	1	single	2	27	N	N	56	*Pseudomonas*	scapha	Y	Y
Hanif et al.[5]	2001	3	16	M	1	single	–	–	Y	Y	2	–	helix	Y	–
			21	F	1	single	–	–	Y	–	–	–	scapha	Y	–
			23	F	1	multiple	120	120	Y	–	–	–	helix and scapha	Y	–
Liu et al.[6]	2013	9	16	F	1	–	–	13	Y	N	–	*Pseudomonas*	helix	N	–
			14	F	1	–	–	14	Y	N	–	*Pseudomonas*	antihelix	Y	–
			17	M	1	–	–	28	Y	N	–	*Pseudomonas*	helix	Y	–
			17	F	1	–	–	9	Y	N	–	*Pseudomonas*	helix	N	–
			22	F	1	–	–	2	Y	N	–	*Pseudomonas*	helix	N	–
			13	F	1	–	–	14	Y	N	–	*Pseudomonas*	helix	N	–
			11	F	1	–	–	4	Y	Y	–	*Pseudomonas*	helix	N	–
			18	F	1	–	–	5	Y	Y	–	*Pseudomonas*	helix	N	–
			34	M	1	–	–	21	Y	Y	–	Nothing isolated	helix	N	–
			15		1	single	–	–				–			N
Cicchetti et al.[9]	2002	5	13	F	1	single	7	–	Y	Y	23	*Pseudomonas*	scapha	Y	–
			13	F	1	single	–	42	Y	Y	23	*Pseudomonas*	helix	Y	–
			18	F	1	single	–	30	–	N	5	Pseudomonas	scapha	Y	–
			32	F	1	single	–	–	–	–	–	–	scapha	Y	–
			10	F	1	single	–	–	–	–	–	*Pseudomonas*	helix	Y	–
Katsanos et al.[10]	2011	1	17	F	1	multiple	14	–	N	–	15	–	helix and scapha	N	–
Lee and Gold[11]	2011	1	15	F	1	single	1	–	Y	Y	38	*Pseudomonas*	helix and scapha	Y	–
Assimakopoulos et al.[12]	2009	1	15	F	2	single	7	11	Y	Y	–	MRSA	helix and scapha	–	–
Fernandez et al[13]	2008	1	14	F	1	single	7	–	Y	Y	29	*Pseudomonas*	helix	Y	–
Rowshan et al.[14]	2008	1	20	F	1	single	7	13	Y	Y	18	*Pseudomonas*	helix	N	–
Sandhu et al.[15]	2007	1	11	F	1	single	8	12	Y	Y	53	*Pseudomonas*	helix	–	–
Manca et al.[16]	2006	1	21	F	1	single	3	–	N	N	20	*Pseudomonas*	helix	–	–
Pena et al.[17]	2006	1	26	F	1	single	14	–	Y	–	7	*Pseudomonas*	helix	Y	–
Stewart et al.[18]	2006	1	12	M	1	multiple	9	20	Y	Y	20	MRSA* *Pseudomonas*	helix	Y	–
Iida et al.[19]	2003	1	17	F	1	single	4	30	N	N	–	–	scapha	Y	excision/conchal graft helical remodeling
Yaholom et al.[20]	2003	1	20	F	1	single	2	–	N	N	7	–	helix	N	–
Serratrice et al[21]	2003	1	29	F	2	single	Multiple	1460	Y	N	365	*Staphylococcus epidermidis*	helix	–	–

TABLE I.
(*Continued*)

Author	Year	n	Age	Sex	Ears	Single or Multiple Piercings	Symptom Duration Prior to Physician Evaluation	Total Symptom Duration (days)	Hospitalized	Intravenous Antibiotics	Total Antibiotic Duration (days)	Cultured Bacteria	Piercing Location	Deformity	Reconstruction
Wu et al.[22]	2003	1	49	F	2	single	2	54	Y	Y	20	*Pseudomonas*	helix	Y	–
Folz et al.[23]	2002	10	–	–	10	–	–	–	–	–	–	–	–	–	–
Kent et al.[24]	2001	10	–	9F,1M	10	–	–	–	–	–	6	6 *Pseudomonas*	–	–	–
Foltz et al.[25]	2000	1	18	F	1	single	2	2	Y	–	3	*Staphylococcus aureus*	scapha	Y	–
Razavi and Schilling[26]	2000	1	16	F	1	single	–	–	Y	Y	14	*Lactobacillus*	helix	N	–
More et al.[27]	1999	2	14	F	2	single	7	14	Y	Y	7	*Pseudomonas*	helix	N	–
			15	F	1	single	7	24	Y	Y	17	*Pseudomonas*	helix	N	–
Staley et al.[28]	1997	2	14	F	2	single	17.5	31.5	Y	Y	18	*Pseudomonas*	–	Y	N
			16	F	2	single	2	16	Y	Y	at least 19, IV not recorded	*Pseudomonas*	–	Y	N
Turkletaub and Habal[29]	1990	1	22	F	1	single	2	15	Y	Y	12	*Pseudomonas*	–	Y	N
Jervis et al.[30]	2001	2	11	F	1	single	3	13	Y	–	–	–	–	Y	N
			14	F	1	single	5	9	Y	–	–	–	–	Y	N
Widick and Coleman[31]	1992	1	20	F	1	single	14	31	Y	Y	At least 16	*Pseudomonas*	scapha	Y	N
Cumberworth and Hogarth[32]	1990	1	34	F	1	single	9	120	Y	Y	–	*Pseudomonas*	pinna	Y	Y
Sanders[33]	1971	1	14	F	1	single	–	–	N	N	7	*Staphylococcus* (coagulase positive)	–	N	–
Margulis et al.[34]	2003	3	21	M	1	single	–	–	–	–	–	–	scapha	Y	Y
			13	F	1	single	–	–	–	–	–	–	scapha	Y	Y
			14	M	1	single	–	–	–	–	–	–	scapha	Y	Y

*Considered a contamination.
F = female; M = male; MRSA = methicillin resistant *Staphylococcus areus*; N = no; Y = yes.

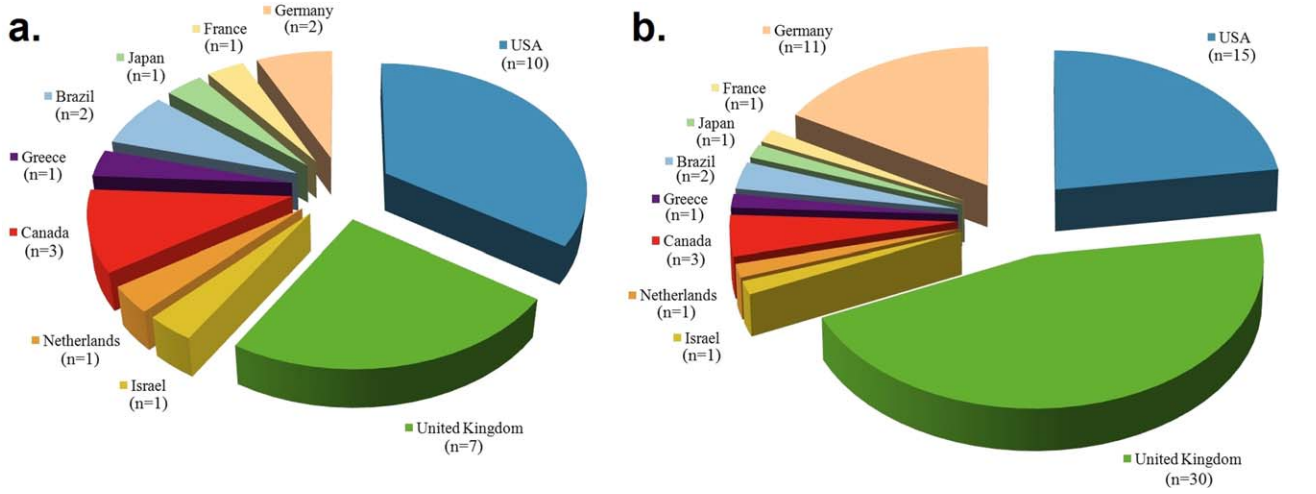

Fig. 2. (a) Studies based on country of origin. (b) Patients based on country of origin. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

more likely to be hospitalized (Table II). A total of 47.8% (33 patients) of cases underwent incision and drainage.[1,5,6,9,11–13,15–19,25–32,34] Of those, nine patients underwent multiple incision and drainage procedures.

Physical findings were reported in 38 patients, with 32 exhibiting purulence at the infected site[1,5,6,9,11–13,15–19,25–32,34] and six without purulent drainage.[5,10,14,17,21,25] Of patients with purulent drainage, 59.4% received intravenous antibiotics; 78.1% underwent incision and drainage; and 53.1% developed an ear deformity. Calculated relative risk for patients with purulent drainage receiving intravenous antibiotics was 1.22 (P = 0.778), for undergoing incision and drainage was 1.84 (P = 0.137), and for developing an ear deformity was 1.17 (P = 0.761). High ear piercings were anatomically identified in the helix (21 patients) and scapha (11 patients). Ear deformity was more likely to occur following postpiercing perichondritis of the scapha 100% versus the helix 43% (P = 0.003).

Microbiology and Antibiotics

Bacterial cultures were documented in 59.1% of cases (n = 39).[1,6,9,11–18,21,22,24–29,31–33] *Pseudomonas aeruginosa* accounted for 87.2% of infections (n = 34)[1,6,9,11–18,21,22,24–29,31–33]; 5.1% (n = 2) of cultures grew methicillin-sensitive *Staphylococcus aureus* (MSSA)[25,33]; and methicillin-resistant *Staphylococcus aureus* (MRSA)[12,18] (n = 1), *Lactobacillus*[26] (n = 1), and *Staphylococcus epidermidis*[21] (n = 1) accounted for 2.6% each. Of the patients with *Pseudomonas aeruginosa*, 92.3% (n = 25) were hospitalized, and 75% of the patients infected with *Staphylococcus* (n = 3) were hospitalized. The relative risk of *Pseudomonas* cultured and the need for hospitalization, intravenous antibiotics, and progression to ear deformity was 1.16, 1.31, and 1.96, respectively, without reaching statistical significance.

A summary of antibiotic selection for oral and intravenous administration is summarized in Figure 4. Initial oral antibiotics prescribed did not target the cultured bacterium in 53.3% of cases (n = 16), of whom 87.5% (n = 14) were hospitalized. Pseudomonal coverage (3rd- and 4th-generation cephalosporins, aminoglycosides, carboxypenicillin, aztreonam, piperacillin/tazobactam, and fluoroquinolones) with initial oral antibiotics was achieved in 20.7% of cases (n = 6). Initial intravenous antibiotic regimens provided pseudomonal coverage in 60% of cases (n = 18). Of the patients receiving an appropriate antibiotic as outpatients (covering gram-positive bacteria and *Pseudomonas*), 100% (n = 16) required hospitalization.

DISCUSSION

The practice of body piercing, particularly high transcartilaginous ear piercings, has become increasingly more celebrated and mainstream among young adolescents in the last 15 years.[1] Transcartilaginous ear piercing is the third most common body piercing outside of the ear lobe.[35] In transcartilaginous ear piercings, the operator will commonly pierce the upper cartilage of the

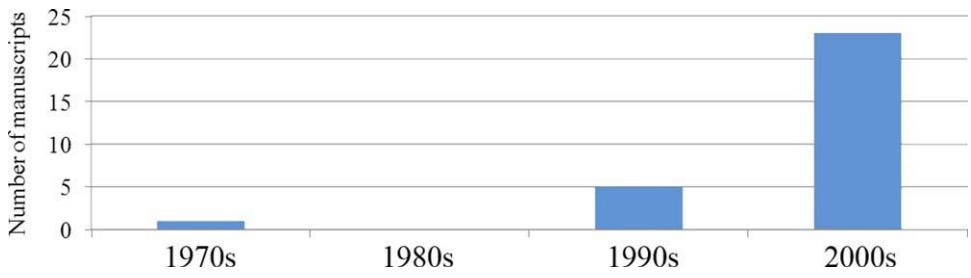

Fig. 3. A graphical depiction of the increased reporting of postpiercing infectious complications in the literature. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

TABLE II.
Drain Placement and Hospitalization Based on Duration of Symptoms Prior to Seeking Treatment.

	Drain Placement			Hospitalization		
Duration of Symptoms	Yes	No	$P = 0.590$	Yes	No	$P = 0.590$
< 3 days	2 (25%)	6 (75%)		6 (75%)	2 (25%)	
4–5 days	0 (0%)	2 (100%)		1 (50%)	1 (50%)	
> 5 days	2 (15.4%)	11 (84.6%)		12 (92.3%)	1 (7.7%)	
	Drain Placement			Hospitalization		
Duration of Symptoms	Yes	No	$P = 1.000$	Yes	No	$P = 0.028$
0–5 days	2 (20%)	8 (80%)		7 (70%)	3 (30%)	
> 5 days	2 (15.4%)	11 (84.6%)		12 (92.3%)	1 (7.7%)	

ear; the scapha; or the most lateral aspect of the cartilage, the helical rim.[1] Localized trauma results in stripping of adjacent perichondrium, leading to devascularization of cartilage; and it introduces microfractures, which increase susceptibility to infection.[1,5] Bleeding between the cartilage and the perichondrium, in conjunction with the neutrophilic reaction, attenuates an already limited blood supply by hydrostatically lifting up the perichondrium and skin.[1,6] Once bacteria are introduced through the piercing tract into the relatively avascular environment, antibiotics have limited effectiveness; thus, incision and drainage are required. The guidance of obtaining cultures and sensitivities are imperative to help guide targeted antibiotic therapy.

This study confirms that postpiercing infectious complications are increasingly being reported in the literature (Table I), reflecting a more popular and socially accepted trend in the United States and internationally (Fig. 2) that is not appropriately met with standards of prevention by local, state, and federal establishments. This study identifies that adolescent and young adult females most commonly develop postpiercing perichondritis. Patients typically delay seeking medical attention to about 1 week following initial onset of symptoms. However, an analysis of delayed presentation did not show any statistically significant difference in the need for drain placement but showed that presenting with greater than 5 days of symptoms was more likely to result in hospitalization ($P = 0.028$).

Once a postpiercing infection is identified, it is imperative to select a broad spectrum antibiotic that covers *Pseudomonas* and *Staphylococcus* species. This systematic review confirms that *Pseudomonas aeruginosa* accounts for the majority of postpiercing cartilaginous infections (87.2%).[36] Of the patients with *Pseudomonas aeruginosa*, 92.3% were hospitalized; and 75% of the patients infected with *Staphylococcus aureus* were hospitalized. However, initial antibiotics prescribed failed to

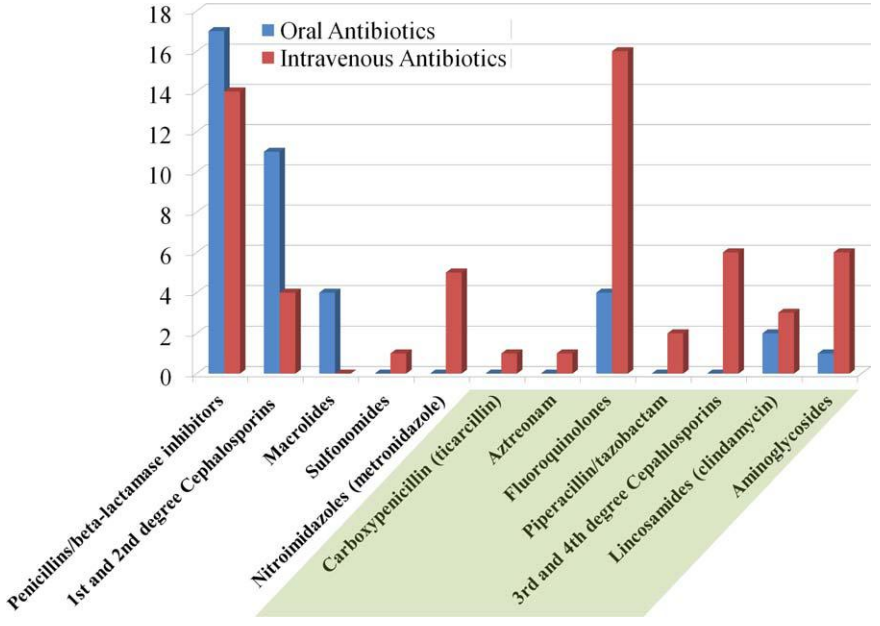

Fig. 4. Summary of antibiotic administration. Antibiotics within the green background cover *Pseudomonas*. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

target the cultured bacterium in just over half of the cases (53.3%), most of which required hospitalization (87.5%). This review underscores the importance of initial oral antibiotic selection because only 20.7% of initial antibiotics covered *Psuedomonas* species. Even upon hospitalization, initial intravenous antibiotics only covered *Pseudomonas* in 60% of cases. It is unclear whether the pathogen virulence or poor choice of antibiosis may have exacerbated infections. Subgroup analysis showed that the odds ratio of hospitalization, need for intravenous antibiotics, and development of ear deformity is increased with *Pseudomonas* infection. Davidi et al. found that in a large case series of patients with perichondritis of varying etiology, those with *Pseudomonaa* infections presented with more severe disease, which required more drainage procedures, and had a longer hospital stay.[37] Interestingly, this systematic revew found that all of the cases who were properly treated with initial antibiotics still required hospitalization. This may be due to delayed intervention because this cohort of patients had a mean time of presenting to a physician of 6.1 days. Based on this evidence, it is unclear whether pathogen virulence or poor choice of antibiosis exacerbates the severity of infection and leads to ear deformity, but delay in treatment past 5 days is significantly associated with poorer outcomes.

As illustrated in Figure 4, the particular antibiotics that were most commonly implemented were the 3rd- and 4th-generation cephalosporins, aminoglycosides, and fluoroquinolones, all of which have antipseudomonal coverage. It is noteworthy to mention that, for both the outpatient and inpatient population, physicians continued to prescribe either penicillins or beta-lactamase inhibitors, which provide no antipseudomonal coverage. Once postpiercing perichondritis or infection is clinically suspected, the practitioner should immediately place the patient on an antibiotic regimen that provides appropriate coverage against *Pseudomonas*.[10,11] Fluoroquinolones have become a mainstay in the treatment, given its broad spectrum and its bactericidal nature, antipseudomonal and antistaphylococcal activity, and robust tissue penetration. In pediatric patients, there is some reservation regarding the use of fluoroquinolones due to the concern for tendon rupture and arthropathy.[10,11] Alternative oral antibiotic choices include but are not limited to ticarcillin, clindamycin, or an oral aminoglycoside. Intravenous administration of the aforementioned antibiotics, as well as aztreonam or 3rd- or 4th-generation cephalosporins, remain potential options for more severe infections.

The particular anatomic involvement of the pinna piercing is directly related to the development of a deforming injury. Scapha piercing was more likely to result in ear deformity compared to the helical rim ($P = 0.003$). This cannot be attributed to the regional blood supply of the ear because both regions have similar vascular supply, notably from branches of the superficial temporal artery and the posterior auricular artery.[36] However, the high rate of deformity should decrease the threshold of physicians to intervene when faced with early postpiercing scapha infections.

In an effort to better define treatment indications, this study evaluated the presence and absence of fluctuance (or purulent drainage) and the rates of intravenous antibiotic administration, rates of incision and drainage, and development of ear deformity. Although dogmatic surgical principles suggest the need for incision and drainage in the presence of ear fluctuance, there was no significant difference in outcomes, regardless of whether fluctuance was present on initial physical examination. Based on our review, health care professionals should be aware that symptom severity resolves within 48 hours of proper treatment, but the mean duration of symptoms may last much longer, to approximately 1 month.

The degree of deformity likely depends on the promptness and efficacy of treatment. Deformities will vary from small contour irregularities of the helical rim to complete absence of the ear.[9] The articles incorporated in this study did not capture ample data regarding time to reconstruction. However, expert opinion (level V evidence) suggests that reconstruction be delayed 6 months to 1 year after complete resolution of the infection.[1,6,7] Reconstruction is individualized for the deformity and may consist of simple scar revision, cartilage sculpting, local flaps with alloplastic material, local flaps with autologous cartilage grafts, or newly described earlobe-based advancement flaps.[38] Most commonly, a local skin envelope can be salvaged and unfurled and wrapped over shaped cartilage grafts taken from the opposite ear. Reconstructive complexity may escalate if initial reconstructions are inadequate.[1]

To date, this is the largest study of postpiercing perichondritis and infection, but there are limitations to this study. The included articles capture only level III and IV evidence, and certain cases do not specify all data points that were collected. Furthermore, this study is susceptible to publication bias and the proclivity of investigators to report exceptional cases rather than typical cases. Given the increasing trend toward upper ear transcartilaginous piercings, the medical and surgical community should be familiar with postpiercing infection and treatment. Future investigations are required to develop better guidelines of treatment and address the potential for bacterial resistance. Moreover, there also is a need for more stringent legislation and documentation of procedures being performed in nonmedical facilities. The risk of complications following high cartilage ear piercing can lead to life-threatening infection and deformity, and it poses another preventable burden to both the patient and health care system.

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