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Review article

Infective Endocarditis After Body Art: A Review of the Literature and Concerns

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Abstract

Purpose: Infective endocarditis (IE) is a rare but dangerous complication of tattooing and body piercing in adolescents and young adults 15-30 years of age, with and without congenital heart disease (CHD). Because body art, including tattooing and piercing, is increasing and IE cases continue to be reported in the literature, a longitudinal assessment of IE and body art cases is important to examine for trends.

Methods: A 22-year (1985-2007) longitudinal electronic Medline and Scopus review of all published cases of IE and body art was conducted.

Results: In all, 22 specific cases of IE spanning 1991-2007 have been reported that were associated with piercing the tongue (seven), ear lobes (six), navel (five), lip (one), nose (one), and nipple (one), and reported in one heavily tattooed person; other general IE cases have also been mentioned. Twelve cases were in females, and one patient died; nine of these individuals had CHD. Twenty-one cases have been published in the 10 years from 1997-2007.

Conclusions: Although there is no denominator to assess the real risk, this review provides more evidence of IE and body art concerns, and should stimulate further discussion regarding IE antibiotic prophylaxis. It is believed that IE is triggered by normal flora at the body art site, microorganism colonization around the jewelry, or by a localized site infection that stimulates episodes of transient bacteremia (commonly caused by staphylococci) and then seeds various areas of the heart. Frequently in such cases the mitral or aortic valves need to be replaced. For individuals with CHD who want body art, prophylactic antibiotic regimens have been suggested since 1999. Millions of tattoos and body piercings are done yearly, and more IE cases are therefore suspected. An international electronic repository of body art complications would provide better documentation. Body art procurement for many persons in this age group is a matter of "when, not if"; thus proactive, frequent, targeted educational strategies for adolescents and artists practicing body art are suggested.

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Keywords:

Endocarditis; Body piercing; Tattooing; Patient education; Antibiotic prophylaxis; Bacteremia; American Heart Association guidelines; Adolescents; Young adults; Congenital heart disease

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World cultures have documented the presence of tattooing and piercing for thousands of years. However, in the past two decades, the "social reality" [1] of body art has moved into the mainstream and become commonplace, especially among adolescents and young adults 15-30 years of age [2]. Several studies, including a recent sequential survey [3] examining body piercing in college students,

have documented prevalency rates of 33% to 51% since 2002 [2-5]. Three of the five studies exclude ear lobe piercings. Tattooing for adolescents and young adults is currently at about 25% [2-5], with a peak estimated at 40% [6]. Individuals of both genders obtain body art, but multiple studies document more females with body piercings and more males with tattoos [2,4,5].

Currently there is widespread body art prevalency; with a documented medical complication rate of 17-19% with body piercing [1,3,4]. Health care providers frequently encounter adolescents and young adults presenting to clinics, schools, emergency rooms, and/or office settings with physical and psychosocial body art complications [1,2,6-8]. Infective endocarditis (IE) is the most dangerous infectious complication of body art [8-13]. The purpose of this article was to conduct a longitudinal review of IE and body art to more closely examine the trends and concerns for a possible correlation. This review is timely because the European Society of Cardiology, the British Cardiac Society/Royal College of Physicians, and the American Heart Association (AHA) have released new guidelines on the prevention, diagnosis, and treatment of IE, and various guidelines and tables are available online (<http://heart.bmj.com/supplemental>) [9]. A statement from the AHA regarding the 1997 prophylaxis guidelines noted that endocarditis prophylaxis is not recommended for ear and body piercing or tattooing [14].

Methods

Although both tattooing and body piercing have existed for a long time, the medical literature before 1985 had scant information about body art. Thus a 22-year longitudinal electronic Medline and Scopus review was conducted for all published cases of IE and body art from January 1985 to December, 2007. Medical articles had to match against (1) MeSH or keyword term relating to endocarditis and (2) MeSH or keyword terms relating to body art, body piercing, or tattooing. All articles relating to IE and body art during the specified time frame were reviewed by each author (n = 21) for inclusion in this review. Articles written in any language were accepted for this review from both national and international publications. All abstracts were in English. If missing data were needed to complete the information for this article, an e-mail requesting specific information was sent to the corresponding author [3,15-17].

Results

Since 1991, at least 22 cases of IE have been associated with piercing of the tongue (seven cases) [10,12,18-23], ear lobes (six cases) [13,16,17,24-26], navel (five cases) [15,27-30], lip (one case) [17], nose (one case) [31], and nipple (one case) [32], and reported in one heavily tattooed male [33] (Table 1). Several other recent cases were pre-

sented but further details could not be obtained as patient and physician responses were anonymous [17].

Often the published IE reports primarily focused on "the first of its kind" situations or on one or two descriptive patient case histories, thus limiting a broader description of the scope of body art complications [34,35]. In addition most IE reports only cited the most recent cases, and rarely included an in-depth, historical perspective. Although only three IE cases were reported from 1991 to 2000 [24,26,31], since 2001 there have been at least two cases of IE published yearly, in 2006 and 2007 there were four [12,13,15,17,25,27,28].

Individuals with IE and body art ranged from 12-30 years of age (mean, 20 years) [36], with more women (12 cases) affected than men (10 cases). One patient died [17]. Symptoms of IE occurred 1 week to 3 months after body art procurement. No recent history of intravenous drug use or human immunodeficiency virus was noted. Individuals with CHD (nine cases) previously had a ventricular septal defect, tetralogy of Fallot, aortic stenosis, right ventricle-to-pulmonary artery conduit, bicuspid aortic valve, tricuspid atresia post-Fontan procedure, and coarctation of the aorta repair. Common causal organisms were various forms of staphylococcus and streptococcus [3,12,36]. All IE patients received intravenous antibiotic administration. In seven cases, this was sufficient IE treatment [15,17,22,25,28,31]. Of the known nine individuals with CHD, five had surgical interventions following their IE [16,24,27,30,32,33], whereas one patient declined the recommended treatment [18]. Twelve patients had surgical procedures for mitral (four patients) [10,12,19,20,29], aortic (four patients) [26,27,30,31], tricuspid (one patient) [13] valves, other valvular defects (one patient) [27], ventricular septal defect (one patient) [24], and the Ross procedure (one patient) [21]. Two other patients declined surgical recommendations [18,26].

Discussion

Incidence of IE

Although still rare, the incidence of IE is reported to be 1.7-6.2 cases per 100,000 individuals in the United States and 3.3 cases per 100,000 individuals in the United Kingdom [36]. The incidence seems to be increasing [11,35], with an estimated 15,000-20,000 new IE cases diagnosed yearly [9,11,36]. Mortality rates range between 4% and 50% [28]. In persons without CHD, post-body art IE seem to target the mitral valve, and these patients were treated successfully with intravenous antibiotics. Approximately 30% of IE cases occurred in individuals with CHD; the IE tended to develop in the location of their congenital lesions and to require surgical therapy as an adjunct to intravenous antibiotics.

Table I
Published cases of infective endocarditis (IE) post-body art procedures

Year	Authors [Ref.]	Age/gender	Anatomical location of body art	CHD lesion/presentation	Symptoms post-body art	Location	Organism	Intervention	Comments
2007	Shebani et al. [17]	13/Female	Ear lobe	CHD/Small VSD	Not specified	UK	<i>S. aureus</i>	TV antibiotics administered, no surgical intervention required	
2007	Shebani et al. [17]	17/Male	Lower lip	CHD/Tricuspid atresia post Fontan	4 Weeks	UK	Streptococcus, type A, then <i>S. aureus</i>	IV antibiotics administered, no surgical intervention required	Died 4 weeks after admission
2007	Kloppenburg et al. [12]	30/Female	Tongue	No CHD/presented with Mitral valve regurgitation	4 Weeks of s/s, but no information when pierced	Netherlands	Streptococcus a-hemolytic	IV antibiotics administered, mitral valve replacement	History of nicotine abuse
2007	Kovarik et al. [13]	15/Male	Ear lobe	No CHD/Presented with Tricuspid valve regurgitation	2 Days	Czech Republic	<i>S. aureus</i>	IV antibiotics administered, tricuspid valve repair	
2006	Lee et al. [25]	15/Female	Ear lobe	No CHD/Presented with Mitral valve regurgitation	7 Days	Korea	<i>S. aureus</i>	IV antibiotics administered, no surgical intervention required	
2006	Barkan et al. [27]	17/Female	Navel	CHD ventricular septal defect/ Presented with loud pansystolic murmur	8 Days	Israel	<i>S. viridans</i>	IV antibiotics administered, VSD closure several months after recovery	
2006	Dupont et al. [15]	16/Female	Navel	No CHD/presented with Tricuspid valve regurgitation	3 Months	France	<i>S. aureus</i>	TV antibiotics administered, no surgical intervention required	Also septic arthritis of wrist
2006	Ferguson et al. [28]	13/Female	Navel	CHD Atrial septal defect/Presented with moderate mitral regurgitation	2 Months	Scotland	Negative blood culture findings	IV antibiotics administered, no surgical intervention required	Vertical gaze palsy Classic signs of IE not always present
2005	Lick et al. [21]	27/Male	Tongue	No CHD/Presented with severe aortic insufficiency	6 Weeks	USA	Streptococcus	IV antibiotics administered, discharged; persistent symptoms, 14 weeks later Ross procedure	Distant history of IV drug abuse
2005	Hoyer and Silberbach [16]	12/Male	Ear lobe	CHD tetralogy Fallot/Presented with narrowed conduit from Right ventricle to pulmonary artery and unrepaired VSD	1 week	USA	<i>S. aureus</i>	IV antibiotics administered, conduit replaced	

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Table I
Continued

Year	Authors [Ref.]	Age/gender	Anatomical location of body art	CHD lesion/presentation	Symptoms post-body art	Location	Organism	Intervention	Comments
2004	Raja et al. [29]	20/Female	Navel	No CHD/Presented with mitral valve regurgitation	1 Month	UK	<i>S. aureus</i>	IV antibiotics administered, mitral valve replacement	1st case of IE, navel piercing with structurally normal heart
2004	Bastiste et al. [23]	25/Male	Tongue	No CHD/Presented with systolic murmur in aortic area	2 Years	USA	<i>S. constellatus</i>	IV antibiotics administered, aortic valve replacement	Also mycotic aneurysm repair
2003	Friedel et al. [10]	26/Male	Tongue	No CHD/Presented with mitral valve regurgitation	2 Weeks	USA	<i>H. parainfluenzae</i>	IV antibiotics administered, mitral valve replacement	
2003	Weinberg et al. [30]	13/Female	Navel	CHD right ventricle-to-pulmonary artery conduit/Presented with conduit valve regurgitation	1 Month	USA	<i>S. aureus</i>	IV antibiotics administered, conduit replacement with aortic homograft	Patient self-pierced her navel
2002	Akhondi et al. [18]	25/Male	Tongue	CHD bicuspid aortic valve effects/Presented with aortic regurgitation	2 Months	USA	<i>H. aphrophilus</i>	IV antibiotics administered, aortic valve replacement recommended	Did not return for OR
2002	Harding et al. [20]; also published by Dubose and Pratt. [19]	15/Female	Tongue	No CHD/Presented with Perivalvular Mitral abscess	2 Weeks	USA	MRSA	IV antibiotics administered, mitral valve replacement	Had brain emboli- Pt. pierced another person with her tongue jewelry, "rinsed with beer" & then replaced it in her mouth

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Table 1
Continued

Year	Authors [Ref.]	Age/gender	Anatomical location of body art	CHD lesion/presentation	Symptoms post-body art	Location	Organism	Intervention	Comments
2001	Trone! et al. [22]	20/Female	Tongue	No CHD/Presented with Mitral valve regurgitation	2 Weeks	France	<i>N. mucosa</i>	IV antibiotics administered, no surgical intervention required	
2001	Satchitananda et al. [33]	28/Male	Tattoo	CHD bicuspid aortic valve/Presented with severe aortic regurgitation	Repeated, monthly tattooing over 5 years	UK	<i>S. aureus</i>	IV antibiotics administered, redo aortic valve replacement	Ist case of IE with repeated tattooing & known valvular disease
2001	Ochsenfahrt et al. [32]	24/Male	Nipple	CHD Coarctation of aorta repair Presented with severe aortic valve insufficiency	2 Months	Germany	<i>S. aureus</i>	IV antibiotics administered, aortic valve replacement	
1998	Papapanagiotou et al. [26]	30/Female	Ear	No CHD!Presented with moderate tricuspid regurgitation	A "few weeks"	Greece	<i>S. epidermidis</i>	IV antibiotics administered, tricuspid valve reconstruction recommended but declined	
1997	Ramage et al. [31]	14/Female	Nasal	No CHD!Presented with mitral valve regurgitation	3 Weeks	USA	<i>S. aureus</i>	IV antibiotics administered, no surgical intervention required	Ist case of IE, nasal piercing with structurally normal heart
1991	Battin et al. [24]	15/Male	Ear	No CHD!Presented with left ventricular and right atrial defects	5 Weeks	UK	Streptococcus	IV antibiotics administered, Gerbode VSD closed	

CHD = congenital heart disease; H. aphrophilus = Haemophilus aphrophilus; H. paraintluenzae = Haemophilus paraintluenzae; IV = intravenous; N. mucosa = Diplococcus mucosus; Ref. = reference; S. aureus = Staphylococcus aureus; S. constellatus = Streptococcus constellatus; S. epidermidis = Staphylococcus epidermidis; S. viridans = Streptococcus viridans; YSD = ventricular septal defect. Symptoms post-body art = length of time between body art procedure and development of symptoms.

Body piercing

Body piercing is thought to be both simple [10] and stylishly risqué [16]; however at least two situations in body art recipients could trigger IE. The first centers around the actual piercing procedure. The quick, invasive penetration of a hollow, large-gauge needle to create a track (skin fistula) for inserting decorative ornaments such as jewelry into the subcutaneous, cartilaginous, and/or mucous membrane areas [7,37] could be the first opportunity for microorganisms to be introduced or jarred loose from the routine site microflora, producing a trigger for transient bacteremia [11,14,17,18,30,31].

The second situation relates more to post-piercing conditions. Specific physical complications can occur at each piercing site. The initial healing of the piercing is site dependent, ranging from 2 weeks to 9 months [34,35]. During the early healing process after the piercing, the site requires consistent, conscientious cleaning. Epithelialization or "toughening of the piercing site" often takes almost a year [7]. The IE could be triggered post-piercing because the tract is a reservoir for bacterial debris, organisms that colonize around or adhere to the jewelry [10], or trauma occurring at the site (as when jewelry is pulled) [36,37]; one or all of these factors could produce an opportunity for transient bacteremia to seed various areas of the heart [18]. Thus, until the tract is closed, it can remain a portal for infections [7]. After undergoing a body art procedure, the recipient should be alert for unexplained fever, night chills, weakness, myalgia, arthralgia, lethargy, or malaise [11].

Self-reported localized body piercings infections range from 17% to as high as 69%; the avascular nature of the mid to high rim cartilage sites ranks the highest [3,5,7]. In our review, we found several IE cases that developed from seemingly "safe" ear lobe piercings. The navel site ranks second in local body piercing infections. Such infections are often caused by under- or overcleaning, which can produce skin irritation and can extend a healing time that is already prolonged by the presence of jewelry in a bacterially contaminated area [7,37,38]. This site is further traumatized by waistband rubbing, vigorous waist movements, and skin moisture in the area [7,37-39].

The common piercing sites associated with IE in the literature review were three, seemingly unrelated anatomical sites of the tongue, earlobe, and navel. Six of the seven patients with tongue piercings [10,12,19-23], as well as one patient with a nose piercing [31], had no known history of underlying CHD. However the oral and nasal cavities are naturally bacteria laden, so the piercing could have triggered either the normal flora at the body art site or the colonization of organisms post-piercing.

Tattooing

A rare case of IE and tattooing was found in this review, involving a male with known CHD receiving monthly tat-

toos over 5 years [32]. In tattooing, indelible designs are created by injecting non -FDA-approved, nonstandardized pigments into the dermis/epidermis junction with between one and 14 solid needles, at the rate of 50-3000 times per minute [2]. Although allergies and photosensitivity are the usual complications post-tattooing, in this case the IE sepsis etiology could be the repetitive pigment injections over a prolonged period.

Reporting of IE

Table 1 reports, to the best of our knowledge, all published articles of post-body art IE since 1985; however, as body art increases and few clinicians publish their problematic clinical experience, there is no current way to accurately assess the true amount of body art or the associated complications [3,7,33]. One suggestion to better assess the situation would be the establishment of national and international Web-based data bases that would be accessible to health care providers and that would provide an effective repository for documenting body art-associated complications [7,9,39]. More cases of IE post-body art were cited in physician surveys. However, in one case it was unclear whether their data were subsequently published and included in this literature review [8], and in the other case it was difficult to trace because of survey anonymity [17]. In another 1990 publication about IE, the two patients had tattoos, but the authors concentrated their examination on intravenous drug use [31].

Fourteen of the published IE cases were in Europe; the other eight were located in the United States (California, Georgia, Michigan, Mississippi, Oregon, Pennsylvania, Texas, and Virginia). In these cases, no environmental trends were noted. There currently are no worldwide standardized body art regulations present either. A 2005 review of body art regulations illustrates the inconsistent regulations across America ([40]; summary available at <http://www.nursing.ttuhsu.edu/Armstrong/StateRegulationsArticle.Pdf>). Globally, body art is not adequately regulated [7]. For example, Korea, like many Asian countries now, has had an increased prevalence of body art and no regulations [25]. Both London, England, and Las Vegas, Nevada, have created stringent guidelines, but their surrounding communities have none [40]. More effective and applicable body art rules for sanitation and sterilization procedures are needed. Specifically, regulations should include single-use items, artist competencies, infection control, client record documentation, and enforcement measures. The Association of Professional Piercers (APP; www.safepiercing.org), an international organization, has been an industry-specific trailblazer providing education for both consumers and artists [37].

Prophylaxis for IE

Pierced areas with relatively diminished blood flow (ears and navel) or high numbers of bacteria (tongue and

lip) are sites for the highest risk of infectious complications [1,3,9,11,15-32]. However, with the documented risks of endocarditis, the question remains as to whether patients with CHD should be subject to the risk and expense of prophylactic antibiotics before they procure their body art. Prophylactic antibiotics for CHD patients requiring extensive dental work has been discussed for many years, but no mention has been made of body art [14]. However 61% of the physician members of the International Society of Adult Congenital Cardiac Disease (ISACCD) [8] and 57% of pediatric cardiologists in 16 medical centers in the United Kingdom have advocated antibiotic prophylaxis for their patients if and when they desired body art, as well as 28% of the Japanese Circulation Society Joint Working Groups for Guidelines for Management of Infective Endocarditis [41]. The majority of the investigators of IE and body art cases (Table 1), as well as others [41-45], have also suggested prophylaxis before piercings, especially until further prospective randomized clinical studies can be conducted [18,19].

Realistic expectations about young persons with CHD and body art

Body art procurement by adolescents and young adults nationally and internationally has been described as a matter of "when, not if" [2,TJ]. Yet, in the ISACCD physician survey [8], 53% disapproved of ear piercing and 75% disapproved of tattooing for their CHD patients. In addition, other investigators [15,19,35,42,43] have specifically recommended against body art for those with CHD. One question that remains is whether focusing on disapproval of body art reduces the emphasis on proactive education. Parents and health providers may not talk about body art, thinking that they will be encouraging body art rather than promoting informed decision making. A second question is whether it is realistic for adolescents and adults with CHD to make appointments with their cardiologists before deciding to procure body piercing or tattoos. A third question is whether the education should include an emphasis on seeking a cardiologist for prophylaxis, or, because IE occurs infrequently, the importance of consulting a cardiologist for prompt treatment if an infection develops after the piercing [43].

Targeted and repeated educational initiatives

Health care providers have tended to concentrate on parental transmission and reinforcement of information about the relationship of IE and body art [46]. To assess this knowledge transfer, several studies [8,46-53] have queried not only parents but adolescents' and children's knowledge about CHD and implications of care. Outcomes repeatedly cite important knowledge gaps [43-53]. Recent body art studies have documented that friends, with or without body art, influence adolescents and young adults about their tat-

tooning and body piercing more than do parents [3,7]. Thus the need for different venues of targeted and repeated education [46] such as CDs, the Internet, and patient literature. A "Dear Abby" column (September 13, 2004) stimulated good discussion. Even patient information created by prestigious medical groups [54-58] need to give more emphasis to the potential for IE in relation to body art. Specifically, education should be developed for the groups described below.

Adolescents and young adults. Individuals in these age groups are often firm in their conviction the matter concerns what are distinctly their choices and their bodies; so, enabled by financial and transportation resources, they ultimately decide about body art procurement, with or without parental permission [40]. If they really want the body art and cannot find an artist to fulfill their requests, they can apply their own tattoos, self-inflict body piercings, or have a friend perform these functions. Vast information about body art is available on the Internet [2,7,55], with procedural illustrations and frequent captions such as, "If you can pinch it you can pierce it." Those who provide care for adolescents and young adults should be involved in education assisting informed decision making regarding body art and the relationship of IE. Importantly, this education needs to be nonjudgmental in approach (*e.g.*, using neutral phrasing, tone, and body language when asking or answering questions), rather than using instructional scare tactics so adolescents and young adults can evaluate the risks and make what they believe to be the right decisions. Recent (March 15, 2007) postings on the Heart Forum (www.medhelp.org/forums/cardio/messages/36293.html) featured parental and adolescent discussion regarding body art and IE.

Body artists. Including body artists is important, because many adolescents and young adults turn for assistance to their body artist or to the Internet, rather than to health care providers, regarding their physical concerns [7,33]. This inclusion follows the same education model that CDC, NIOSH, and APP have done recently with their targeted campaign materials for reducing blood-borne pathogen exposures within the body art industry ([www.cdc.gov/niosh/topics/bbp/body art!](http://www.cdc.gov/niosh/topics/bbp/body%20art/)). In a 2006 study [36], 32% of the body piercers said that they would pierce tongues of adolescents less than 18 years of age; and, although most piercers (86%) inquired about a client's medical history, only one was aware of an IE risk after piercings. The current APP Web site (www.safepiercing.org/healthconsiderations.html) has effective warnings about IE aimed at both piercers and piercees; yet, because of the low membership of this organization, a concerted effort to disseminate this information is still important. Providing the body artists with the correct information will help them to effectively prescreen their clients, encourage vulnerable clients to seek prophylaxis

before piercing, and emphasize aftercare instructions that are more applicable to the individuals involved.

In summary, the cultural trends of tattooing and body piercing seem to be embedded in part of our contemporary society's mosaic, continually increasing the number of individuals with body art. Although 21 cases in 10 years (1997-2007) does not reach epidemic proportions, further investigation and discussion regarding relationship of body art, IE, and antibiotic prophylaxis should continue, both nationally and internationally, given the increase of body art and the number of published cases of infection. In addition, worldwide, standardized body art regulations for the industry are important.

Added in Press

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