Review Article on Current Management Aspects in Adult Congenital Heart Disease (ACHD): Part IV

"Body modification: piercing and tattooing in congenital heart disease patients", decoration or disaster?—a narrative review

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Objective: Tattoos and piercings are types of body art, which are gaining popularity over the last decades. An increasing number of adolescents and adults with congenital heart disease (CHD) have piercings or tattoos. This review will provide prudent information on the subject for affected patients and health care professionals caring for them.

Background: Amongst others, local infections are a common complication in up to 20% of all piercings and isolated cases of systemic infections like endocarditis have been reported. Individuals with congenital heart disease are especially susceptible to endocarditis and prone to suffer severe health consequences from it. In terms of tattooing endocarditis is less common but the localization must be well considered as it might interfere with cardiovascular magnetic resonance imaging (CMR), which constitutes an important part of follow up investigations in these patients.

Methods: This article is written as a commentary narrative review and will provide an update on the current literature and available data on common forms of body modification and the potential risks for patients with CHD.

Conclusions: In order to best advise patients and their families, health care professionals must be aware of potential risks accompanying the implementation of body art. Neither the European nor the American guidelines for endocarditis prophylaxis address piercings and tattoos. To our knowledge, there are no clear recommendations concerning piercings and tattoos for adolescents and adults with CHD.

Keywords: Body modification; tattoo; piercing; endocarditis; congenital heart disease (CHD)

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Background

The prevalence of congenital heart disease is about 1% (1). The improvement of care available for these patients, results in an increase in the number of adolescents and adults with complex congenital heart disease who enjoy relatively good health. These patients, who in many ways feel and act like their peers, wish to live a "normal" life. As part of that, body modification might become an issue for individuals with CHD (2-4).

Tattoos

Decorative changings to the human body have been carried out for thousands of years since the pre-Christian era. One of the oldest bodies found with a tattoo is "Ötzi the Iceman", a mummy that dates back to 3000 BC (5). In 1765 the British captain Cook described people who painted their bodies with colours and thereby pictured the Polynesian technique of "tattaw" in the narrative of his voyage (5).

Tattoos still serve as marks of status and rank, symbols of religious or spiritual devotion, indicators of an important event like a deep love or friendship, and in those days as stamps of slaves and prisoners. Today tattoos are mostly done for cosmetic or religious reasons, to symbolize the belonging to a particular group or as a marker of individuality (2).

Permanent makeup as a subtype of tattoos is used to enhance lips, eyes and eyebrows and is quite common regardless of social status.

In industrial countries between 10% and 25% of all people have at least one tattoo with a rising trend. Traditionally the prevalence of tattooing was higher in men, but within the past 20 years, the trend has progressively changed and women are catching up (6).

For some people, tattoos are a way of coping with their own history. Sparkes *et al.* report about the body modification of five athletes after spinal cord injuries constructing or reconstructing their bodies with tattoos over time (7). David Allen, a tattoo artist from Chicago reports of the "healing role of Postmastectomie-Tattoos" for women with breast cancer (8).

As a non-permanent option, henna tattoos are an alternative to permanent tattoos. Henna-based temporary tattoos may be purely decorative or have ritual meaning (9).

Piercings

The history of piercings goes back to a similar time as described above for tattooing. Archaeological evidence of body piercing and body modification dates back at least 5,300 years, with the ears, nose, and mouth identified as the earliest known pierced body sites. For example, the Mayas used piercings as an important ritual with spiritual or developmental dimension. In the western culture piercings of the earlobe were only accepted in women until the beginning of the 1970's. In the 1970s and 1980s social movements utilized body art as markers of rebellion or group identity (4). Since the 1990s piercings are excepted and the popularity is increasing (2). Due to the media representation the number of pierced individuals increase across all social classes and socioeconomic groups.

The most common places for piercings are the soft earlobe or cartilage above, navel, eyebrow, tongue and nipples (4). Up to 30–50% of young people have at least one piercing at a side other than the ear (10). We present the following article in accordance with the Narrative Review reporting checklist (available at https://dx.doi.org/10.21037/cdt-21-458).

Methods

Providing advice to adolescents and adults with CHD on tattoo or piercing requires profound knowledge of the act of implementation and associated risk factors. Even though body art is gaining popularity and social acceptance, most healthcare professionals are not well informed and therefore uncertain of what to recommend to their patients.

This article is written as a commentary narrative review and will provide an update on the current literature, discussing the existing data from the point of view of paediatric cardiologist caring for adolescents and adults with congenital heart disease. We hope to offer an informative basis for the affected patients, families, and health care professionals.

Results

In the last two decades several studies and case reports were published highlighting the issue of tattoos and piercings from different points of view. Positive effects as well as possible side effects, and their significance for people with chronic diseases, including skin disease and congenital or acquired heart defects, were addressed.

When considering highly developed countries, in most cases the hygienic standards for invasive procedures including piercings and tattoos are high. Infections from non-sterile needles and other instruments have therefore

become exceedingly rare. Nevertheless, there are still several risk factors that must be considered, before settling upon either a tattoo or a piercing. As Kluger and De Cuyper highlight in their publication from 2018 the tattooist should be aware of any medical condition affecting the client and provide good aftercare.

Problems and procedural risks

Tattoos

About 1–5% of people have tattoo-related bacterial infections (11), which have the potential of being especially dangerous for patients with CHD who are susceptible to endocarditis.

Ornamental tattoos after surgery gain more popularity and are preferred by many patients as an aesthetic alternative for scar correction. Any scares (>1 year of age) are not a contraindication for tattooing (12). Patients after cardiac surgery often have a scar from a median sternotomy. The localization of a tattoo on the chest might interfere with CMR (cardiovascular magnetic resonance imaging), which became part of the routine aftercare for patients with CHD (13,14).

Local reaction and infection

Several medical reports describe the extent of local reaction after tattooing, and show a dependence on size, colour, ingredients of used ink, skin conditions and immune reaction (9). Bleeding due to inherited or acquired blood disorders or antithrombotic treatment like aspirin or anti-vitamin-K can occur and should be discussed in advance with the attending physician (15). By breaking the skin barrier there is always a potential risk for penetration of infectious agents like bacteria, viruses and fungi. Even with appropriate precautions contamination of tattoo machines or ink can occur leading to local infections (6,16).

About 1–5% off tattoo recipients suffer from tattoo related skin infection, generally caused by *Staphylococcus aureus* or *Streptococcus pyogenes* with manifestation of signs and symptoms around 4–22 days after the procedure (17). As reported by Dieckmann *et al.* up to 10% of ink bottles contain relevant numbers of bacteria. Open ink containers were found to hold high numbers of gram-negative germs like *Pseudomonas aeruginosa*, unopened ink bottles contained low counts of bacilli or other spore forming bacteria (6). Several Immune-mediated reactions were previously described (including necrobiotic, lichenoid, tuberculoid and sarcoid granulomatous reactions) (16). Allergic reactions have been reported to be more common when red ink was used. This observation is still valid even after changing the colour ingredients. Black is the most common colour for tattoos and is associated with delayed allergic reactions (18).

Systemic Infections and Endocarditis

The main concern for patients with CHD receiving a tattoo is the risk for systemic infections and infectious endocarditis (IE). Several case reports and reviews outline the risk for IE associated with tattooing (6,19-24). Even though only a small number of IEs is reported, the cases tended to affect the congenital lesions and necessitate surgical repair as an adjunct to intravenous antibiotics (20).

The potential for transmission of hepatitis B (HBV) and C (HVC) as well as human immunodeficiency virus (HIV) by getting a tattoo is virtually non-existent anymore in developed countries with adequate hygiene standards as long as it is done in professional tattoo parlour with sterile disposable needles and proper equipment (16).

CMR and computed tomography

Wang *et al.* state, that clinicians should be aware of the minimal but increased risk for burns in patients with tattoos, particularly when >30 cm or in sensitive regions. These are more probable when using a 3-T magnet which is more likely to produce a current in it as compared to a 1.5-T magnet (25).

Nourreddine *et al.* investigated 108 volunteers with one or more tattoos undergoing 7-T imaging with two tattoos directly and 24 in the vicinity, but not directly within the exposure volume of the transmit coil. They reported that none of the subjects indicated any sensation of heat or discomfort. Reddening in the area of the tattoo was not observed (26).

Metabolism and carcinogenicity

Tattoo pigments can react with the surrounding tissue and be subject to intracellular uptake after intradermal deposition. The existing data about skin cancer possibly related to tattoos is scarce and has many confounding social and environmental factors, so that any association must be regarded as coincidental (12).

Removal

Up to 50% of tattoo recipients have second thoughts about their decision of having a tattoo, but only a few finally pursue removal due to high costs and the risk of scaring (12).

In 97% laser removal treatment leads to transient local symptoms including pain, blistering, crust formation and oedema. Patients with local or systemic allergic reactions tend to exhibit more severe symptoms during removal. Hypo- and hyperpigmentation as well as scaring have been reported as potential permanent side effects irrespective of any underlying medical condition (9).

Permanent make up

Permanent make up is described as time saving and popular amongst people with health conditions that create a barrier to make up application. As most colorants are manufactured for non-medical purpose mild to moderate, rarely severe skin reactions may occur depending on the used pigments, diluents, binders and preservatives (9,16). As permanent make up is a subgroup of tattoos possible side effects in general are comparable to those described above.

Henna tattoos

Traditional henna dye, as an alternative to permanent tattoos, is made of the leaves from the tree Lawsonia inermis and has a typical brown colour. Para-phenylenediamine (PPD) is frequently added to henna tattoos to create a black colour and may cause severe allergic contact dermatitis (ACD). As Ferrari reports in a group of 10–20-year-old almost all patients with a PPD contact allergy were sensitized by application of temporary tattoos. Especially adolescents are at higher risk to develop ACD due to henna tattoos (27,28).

Piercings

Healing of the pierced site can take weeks to months, depending on the vascularity and exposure of the site. In takes at least one year until the tract is fully epithelialized. During this time, the piercing site will continue to require judicious care. The overall rate of complications is reported with 17–46% in all body piercings (4).

Local infections

In a population of 744 American and Australian college students 45% report infections at the site (blister, pus, drainage, pain, and redness) (29).

Staphylococcus aureus is the most common organism associated with cutaneous infections, followed by group *A Streptococcus* and *Pseudomonas spp*. Infected genital piercings are caused by *Escherichia coli*, *Klebsiella spp*, *Proteus mirabilis*, *Enterococcus spp*, and *Staphylococcus saprophyticus* (4,10).

Another special site is the cartilage of the ear with its avascular nature. Piercings through the cartilage lead to edema and bleeding into the cartilage with increased susceptibility to infections. Based on this infections of the auricle are relatively nonresponsive to oral antibiotics and require an early hospitalization for intravenous therapy (4).

Systemic Infections and infectious Endocarditis

Any percutaneous exposure has the potential of transferring infectious blood. Blood borne diseases (e.g., hepatitis virus and HIV) might be transferred when the guidelines for sanitations and equipment precaution are not followed. An obvious risk of HIV transmission does exist if instruments contaminated with blood are either not sterilized or disinfected or are used inappropriately between clients (29).

Several case report and reviews exist describing severe cases of IE after body piercing with different frequencies and underlying infectious agents, depending on the localization. Some, but not all patients, had infections affecting grafts or valves involved with previously described heart disease (20,30-32).

In a series of 22 cases, IE was associated with piercings of tongue (seven), ear lobes (six), navel (five), lip (one), nose (one) and nipple (one) (20). *Staphylococcus aureus*, *S. epidermidis*, *Neisseria sp. or Streptococcus sp*. are infectious agents which are found in different sites as colonization. These agents are typically associated with IE and can usually be detected in blood cultures and in worst case scenarios in removed tissue or prosthetic material.

Non-infectious complications

Bleeding, tissue trauma and local problems like chipped or broken teeth following mouth or tongue piercing are the second most common physical health problem, after infection, associated with body piercing (29,33). Especially at sites with high vascularity (tongue or penis) disruption of platelet aggregation from Aspirin or nonsteroidal anti-inflammatory drugs (NSAID's) can lead to extended bleeding and should be avoided for at least 7 days before and after piercing (4,34).

CMR or computed tomography

Most published articles focus on the safety of performing an

MR scan with body jewellery. Higher-quality body jewellery containing stainless steel, titanium or niobium has found to be safe even if worn during the MR examination (35). A possible, tough not fail-safe screening method is described as testing the jewellery outside the MR suite with a handheld magnet. A safe method to replace the piercing during the procedure is described by Muensterer (see Surgery) (36).

Surgery

For surgical interventions piercings must be removed to prevent electrical burns caused by electrocauterization. Since the subcutaneous tract closes quickly depending on localization and age a non-metallic spacer is indicated. Muensterer reported about five patients with surgical or radiologic interventions, in which a 14- or 16-gauge intravenous catheter (without the needle) was placed as a spacer for navel piercing after proper disinfection for the time of the intervention. No side effects occurred due to this procedure in the follow up period (36).

Special considerations for Patients with CHD

In 1999 Cetta *et al.* investigated the frequency and safety of ear piercings and tattoos by sending a survey to children and adults with CHD as well as physicians caring for adults with CHD in the United States. Due to the small number of participants a general recommendation for or against an antibiotic prophylaxis could not be made. In 2004 Shebani *et al.* evaluated 486 patients and 68 consultants from the UK with a questionnaire asking for whether they had or were planning to have body art, whether they were aware of the increased risk of endocarditis, and if they had or were planning to seek advice.

They concluded that there appears to be no consensus amongst professionals as to the correct advice to give to individuals at risk and that better knowledge and education about the link between body art and endocarditis is required in order to provide guidelines for doctors and patients (37). Additionally, in 2004, Dähnert *et al.* published a review article of 10 case reports with endocarditis after piercing or tattooing, 4 of them with known congenital heart disease. They assumed, that Patients with congenital heart disease are at increased risk for infective endocarditis resulting from body piercing and tattooing and therefore should be advised to avoid tattoos and piercings (21).

In another survey published in 2014 Knöchelmann *et al.* examined the maternal knowledge about infective endocarditis for children with CHD and concluded that education-efforts should be focused on mothers of children requiring IE prophylaxis (38). In Azhar *et al.* found that only about 40% of caregivers received general information about IE and only one third or less could explain risk factors, symptoms and prophylaxis of IE (39). Since many patients with CHD receive anticoagulants or anti-platelet-aggregation drugs, some high vascularity sites for piercings like tongue or penis should be avoided.

Van Hoover even states, that those with cardiac conditions associated with the highest risk of endocarditis should avoid body piercing. Further specific contraindications are named as use of anticoagulant and/or antiplatelet medication, cardiac valvular disease, congenital heart disease (4).

"Transition consultation" can be conducted by a specialized professional (e.g., nurse) and offers time and space to discuss issues pertaining to adolescence and adulthood and how they are affected by the underlying congenital heart disease. These consultations are therefore the perfect setting for addressing possible plans of body modification. We have established such a transition consultation in our outpatient department in 2015 and receive very positive feedback from our patients.

Conclusions

Tattoos and piercings are accompanied by a moderate risk for mild to severe side effects, potentially leading to serious medical conditions. For adolescents and adults with congenital heart disease some special issues must be considered. Since recommendations from international professional societies for patients with congenital heart disease have not yet been established, educational talks about body modification should be offered in transition consultation. Guiding our patients through issues like this might help protect them against foreseeable complications from procedures. The reality of body art being a part of life for many people regardless of their health status cannot be ignored and a general ban often leads to the opposite. Offering advice regarding prophylaxis and symptoms of infectious endocarditis, the "best" individual localization to choose for body art and its aftercare, as well as encouraging patients to seek help if local infections occur might be valuable. Furthermore, advising patients about how to choose a good tattoo- and piercing-studio and point out alternatives like fake piercings or henna tattoos might be helpful in protecting them from harm. In *Table 1*, we try to

Table 1 Recommendations

Body modification type	Prudent information for patients with CHD
Tattoos and Piercings in general	• The topic should be addressed, preferably during transition consultations
	• Patients should be encouraged to seek advice in advance from their attending physician
	• Hygiene standards should play a key role when choosing the studio
	• Aftercare instructions should be handed out to the Patients by the studio and possibly double checked by the attending physician
	• Patients ought to be instructed to seek early medical attention if local infection occurs
	• Postprocedural fever must be taken seriously and lead to an immediate consultation
Tattoos	• Large and circular tattoos on the chest should be avoided, if CMR is likely to be part of the follow up routine
	• The ingredients of the ink ought to be checked for possible allergens before tattooing
Piercings	• Anticoagulants and anti-platelet aggregation drugs are a contraindication for piercings at the cartilage of the ear, tongue or penis
	• Hypoxemia (SaO_2 <90%) is a contraindication for cartilage piercing

provide concrete assistance for daily practice.

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