

CRYSTAL M. GLASSY, DO, MPHUniversity of California, Irvine,
Department of Family Medicine,
Irvine, CA**MATTHEW S. GLASSY, MD, MS**University of California, Irvine,
Department of Internal Medicine
Irvine, CA**SALEH ALDASOUQI, MD, FACE, ECNU**Michigan State University,
Department of Medicine, Lansing, MI

Tattooing: Medical uses and problems

ABSTRACT

Decorative tattooing is a custom thousands of years old and is growing in popularity today. Medical professionals may be less familiar with its medical applications—medical alert tattooing, reconstructive and cosmetic applications, endoscopic tattooing, corneal tattooing, tattooing in radiation oncology, and uses in forensic medicine. We review current medically related tattooing applications and discuss their potential risks and benefits.

KEY POINTS

Tattoos that state an advance directive for health care are not recognized as meeting the legal requirements for advance directives. They should only be considered as a guide to treatment decisions.

Tattooing for medical-alert purposes is part of current culture. People with diabetes should avoid tattooing of feet or lower legs in view of impaired healing.

Endoscopic tattooing is commonly used to aid visualization of diseased bowel segments during laparoscopic surgical procedures. Complications are rare but include mild chronic inflammation, abscesses, inflammatory pseudotumors, focal peritonitis, and peritoneal staining.

Improper sterilization of tattooing needles can cause a wide range of infectious diseases and skin reactions.

PEOPLE HAVE BEEN MARKING the skin with pigments for at least 4,000 years.¹ Tattoos have been found on Egyptian mummies, and Roman gladiators are known to have used tattoos for identification.² Tattooing was considered fashionable among royalty in the first half of the 20th century.³ And today it is perhaps more popular than ever.

But tattooing is not confined to popular culture and decoration. It has established uses in medicine, as well as other medically related uses that represent more recent trends. In this review, we explore the range of medical tattooing.

MEDICAL ALERT TATTOOING

Medical alert tattooing is a form of medical identification similar to medical alert jewelry, ie, bracelets and necklaces, to alert first-responders to a medical condition or to specific desires for care, such as do-not-resuscitate (DNR) directives.

Some people choose to have their medical condition tattooed rather than wear medical alert jewelry, which can break or be misplaced.⁴⁻⁶

This practice is currently unregulated by the medical community, and the few reports of its use published to date include two people with diabetes who had the word “diabetic” tattooed on their bodies,^{4,5} and a woman with a tattoo warning of a past severe reaction to succinylcholine during anesthesia.⁶ She had been advised to wear medical alert jewelry, but she instead chose a tattoo.

Blood-type tattooing was briefly used in a few communities in the United States in the early 1950s as part of a program to provide a “walking blood bank.”⁷ However, the practice



FIGURE 1. Examples of tattoos patients have had done at tattoo parlors to alert emergency medical personnel to medical concerns. At left, a tattoo on the left wrist of a man, age 37, who had had type 1 diabetes since the age of 2. At right, tattooing on the left forearm of a woman, age 28, who had had type 1 diabetes since the age of 2.

THE PHOTOGRAPH AT LEFT IS REPRINTED WITH THE PERMISSION OF THE AMERICAN ACADEMY OF FAMILY PHYSICIANS, FROM REFERENCE 5.

Some patients may prefer tattooing instead of a medical alert bracelet or necklace

fell out of favor as physicians questioned the reliability of tattoos for medical information.⁷

This type of tattooing could also benefit patients with adrenal insufficiency, O-negative blood type, and allergies, and patients taking an anticoagulant drug (after discussing the risks of bleeding with their primary physician).

Emergency medical technicians are trained to search unresponsive patients for health-related items, including medical alert necklaces and bracelets. Since tattooing for disease identification purposes is not an officially recognized procedure, these personnel need to be aware that this practice is increasing among the general public. Identifying medical alert tattoos in emergency situations is much more difficult in people with extensive decorative tattooing.

Tattoos indicating health directives

Reports of people with tattoos indicating health directives (DNR, do-not-defibrillate) have prompted debate over the validity of tattoos as a type of advance directive.⁸⁻¹³ These types of tattoos pose practical and ethical problems: they may not reflect a person's current wishes, and they may have even been applied as a joke.¹³ Furthermore, they are not recognized as meeting any of the legal require-

ments for advance directives, so they cannot be considered as valid health directives, but only as a way to guide treatment decisions.¹⁴

The same is true for the other ways of notifying first-responders to one's treatment wishes, ie, wallet cards and medical alert bracelets and necklaces. One manufacturer of medical alert bracelets and necklaces offers to engrave that the wearer has a living will and to keep on file a copy of the document, which they can fax or read out loud to paramedics if they are contacted.¹¹

Organ donor tattoo

In the case of a man who had his consent to be an organ donor tattooed on his chest,¹⁵ the tattoo was viewed as not equivalent to signed documentation; however, such tattoos can be used to help guide management.¹⁵

DIABETIC PATIENTS AND MEDICAL ALERT TATTOOS

Medical alert tattooing is increasingly common in people with diabetes. Discussions on social-networking sites on the Internet indicate that diabetic patients often do this on their own without consulting their physician.

In our clinic, we have encountered patients with tattoos on the wrist (FIGURE 1),

similar to those seen on the Internet, typically displaying a six-pointed star of life, a caduceus (physician's staff), and the word "diabetic." Patients we have encountered in the past 3 to 4 years have cited the same rationale for resorting to medical tattooing—ie, the cost of repeatedly replacing broken and lost medical alert jewelry.

We believe there is a convincing rationale for diabetic patients to undergo medical tattooing, and we believe that diabetes organizations need to evaluate this and provide education to patients and clinicians about it, so that patients can discuss it with their care providers before taking action on their own.

Risks of tattooing in diabetic patients

Diabetic patients who ask their physician about getting a diabetes-alert tattoo should be informed about the dangers of tattooing in diabetes. The diabetes should be optimally controlled, as gauged by both hemoglobin A_{1c} and mean blood glucose profile at the time of tattooing, in order to promote healing of the tattooed area and to prevent wound infection.

Also helpful is to advise diabetic patients to avoid tattooing of the feet or lower legs in view of the risk of diabetes-related neurovascular disease that may impair healing or incite infection.

■ RECONSTRUCTIVE AND COSMETIC TATTOOING

Areolar reconstruction

Breast reconstruction after mastectomy is fundamental to the psychosocial health of the patient and helps her regain a positive body image.^{16,17} Tattooing of the nipple-areola complex¹⁶ is usually the final step of the breast reconstruction process.

Complications of areolar tattooing are rare but can include local erythema and infection.¹⁸ And patients should be informed that the tattoos will likely fade over time and require re-tattooing.¹⁸

Tattooing as camouflage

Tattooing is used to repigment the skin in conditions that cause hypopigmentation or hyperpigmentation,² including burns.¹⁹ It is also used as an alternative to laser treatment in port-wine

stain and in cosmetic surgery of the scalp.²⁰

Tattooing is used for micropigmentation of the lips and fingertips in patients who have vitiligo. However, this should be reserved for those with stable vitiligo, since tattooing may trigger another patch of vitiligo at tattoo sites.²¹

Although medical management exists for vitiligo, it is often ineffective for lip vitiligo since the success of medical therapy depends on the pigment-cell reservoir at the site of depigmentation. The lips lack such a reservoir of melanocytes, so tattooing may be an option.²²

Corneal scarring

Perforating injury, measles keratitis, and other conditions can result in cosmetically disfiguring discoloration of the cornea. When microsurgical reconstruction is ineffective or is not an option, corneal tattooing has been reported to provide satisfactory results at up to 4 years.²³ Reopacification, increased opacity, fading of the tattoo pigment, and epithelial growth have been reported, and in one series, most patients required reoperation.²⁴

Tattooing to hide surgical scars

Spyropoulou and Fatah²⁵ reported three patients in a plastic surgery practice who underwent decorative tattooing to camouflage cosmetically undesirable scars. The authors suggested this as a valid option, especially in younger patients, among whom tattooing is common and acceptable.²⁵

'Permanent makeup'

Tattooing is also used to simulate makeup ("permanent makeup") and may be beneficial to people allergic to conventional makeup or people with disabilities that make applying makeup difficult.²⁶ Complications of this procedure include bleeding, crusting, swelling, infection, allergic reactions, hypertrophic scars, keloid, loss of eyelashes, eyelid necrosis, and ectropion, as well as complications related to magnetic resonance imaging (described further below).

Most pigments used for this purpose do not have an established history of safe use, and patients may experience severe allergic reactions. A recent report described severe allergic reactions resistant to topical or systemic

'Permanent makeup' tattooing may be beneficial to people with allergies to conventional makeup or with disabilities that make applying makeup difficult

therapy with steroids in combination with topical tacrolimus (Prograf), especially after exposure to red dye 181.²⁷ Researchers have recommended the regulation and control of colorants in permanent makeup.²⁷

■ RADIATION ONCOLOGY

Tattooing is used in radiation oncology to ensure accurate targeting of radiation therapy. Typically, several small, black marks 1 to 2 mm in size are applied by a medical professional using an 18- or 19-gauge hypodermic needle and india ink.² The marks are permanent.

Although these markings are clearly helpful during radiation treatment, they can be psychologically upsetting to patients, as they are a constant reminder of the disease and the treatment, both during the treatment course and long after it is finished.

An alternative is to use temporary marks for the 6 to 7 weeks that patients typically need them. However, temporary tattooing is prone to fading, and this is a key limitation.

■ ENDOSCOPIC TATTOOING

In laparoscopic gastrointestinal surgery, lesions are often difficult to visualize and localize since the surgeon is unable to palpate the bowel directly to identify the diseased segment; this increases the risk of resecting the wrong segment of bowel.²⁸ Endoscopic tattooing of the segment to be resected greatly improves the accuracy of laparoscopic procedures. Endoscopic tattooing is also used to facilitate identification of subtle mucosal lesions or endoscopic resection sites at the time of subsequent endoscopy.^{29,30}

India ink or a similar presterilized commercial preparation is commonly used.³¹ Complications are rare but include mild chronic inflammation, hyperplastic changes, inflammatory bowel disease, abdominal abscess, inflammatory pseudotumor, focal peritonitis, peritoneal staining, and, very rarely, seeding of tumor via the tattooing needle.³⁰

■ FORENSIC MEDICINE

Specialists in forensic medicine use primary markers such as fingerprints and dental records

and secondary markers such as birthmarks, scarring, and tattoos to identify victims.³² Tattoos are useful for identification when fingerprints or dental records are unavailable,³³ as in the tsunami of December 2004 in Southeast Asia³⁴ and the London Paddington train crash of October 1999.³⁵ However, as the body decomposes, tattoos can discolor and fade, making them hard to identify. Application of 3% hydrogen peroxide to the tattoo site has been reported to aid in identification, and infrared imaging has shown promise.³²

■ GENERAL RISKS AND COMPLICATIONS OF TATTOOING

Improper sterilization of tattooing needles and tattoo ink in public tattoo parlors can cause a wide range of diseases and skin reactions.³⁶⁻⁴⁴

Infection

Pyodermal infections can include temporary inflammation at the sites of needle punctures, superficial infections such as impetigo and ecthyma, and deeper infections such as cellulitis, erysipelas, and furunculosis.

Other transmissible infections include hepatitis, syphilis, leprosy, tuberculosis cutis, rubella, chancroid, tetanus, and molluscum contagiosum. An outbreak of infection with *Mycobacterium chelonae* from premixed tattoo ink has also been reported.⁴⁴

Hepatitis C has been shown in epidemiologic studies to be transmissible via nonsterile needles. Human immunodeficiency virus is also theoretically transmissible this way, but this is difficult to confirm because the virus has a long incubation period.³⁶

Cutaneous reactions

Skin reactions to tattooing include aseptic inflammation and acquired sensitivity to tattoo dyes, especially red dyes, but also to chromium in green dyes, cadmium in yellow dyes, and cobalt in blue dyes.³⁸ The reaction can manifest as either allergic contact dermatitis or photoallergic dermatitis.

Cutaneous conditions that localize in tattooed areas include vaccinia, verruca vulgaris, herpes simplex, herpes zoster, psoriasis, lichen planus, keratosis follicularis (Darier disease), chronic discoid lupus erythematosus, and ker-

The metallic pigments in tattoos can conduct heat and cause burns during magnetic resonance imaging

atoacanthoma.

Other possible conditions include keloid, sarcoid granuloma, erythema multiforme, localized scleroderma, and lymphadenopathy.^{36,37}

Malignancy

Malignancies reported to arise within tattoos include squamous cell carcinoma, basal cell carcinoma, malignant melanoma, leiomyosarcoma, primary non-Hodgkin lymphoma, and dermatofibrosarcoma protuberans.³⁹ These malignancies may be considered coincidental, but carcinogenicity of the tattooing colorants is a concern to be addressed. Nevertheless, a malignancy within a tattoo is more difficult to identify on skin examination.

Burns during magnetic resonance imaging

The metallic ferric acid pigments used in tattoos can conduct heat on the skin during magnetic resonance imaging,⁴⁰ resulting in traumatic burns. This has also been reported to occur with tattoos with nonferrous pig-

ments.⁴¹ Patients should be asked before this procedure if they have tattooing so that this complication can be avoided.

Two other complications

Two interesting complications of tattooing have been described. First, tattoo pigments have been noted within lymph nodes in patients with melanoma.⁴² This finding during surgery could cause the surgeon to mistake tattoo pigment for disease and to complete a regional lymph node dissection if biopsy of the sentinel node is not performed.

The other involved disseminated hyperalgesia after volar wrist tattooing. The authors speculated that the pain associated with volar tattooing may have been related to the proximity of the tattoo to the palmar cutaneous branch of the median nerve.⁴³ ■

ACKNOWLEDGMENT: The authors would like to acknowledge the patients in Figure 1 for their permission to use their photos and Nicolas Kluger, MD, Departments of Dermatology, Allergology, and Venereology, University of Helsinki, Finland, for his input into an early draft of this manuscript.

REFERENCES

1. Grumet GW. Psychodynamic implications of tattoos. *Am J Orthopsychiatry* 1983; 53:482–492.
2. Vassileva S, Hristakieva E. Medical applications of tattooing. *Clin Dermatol* 2007; 25:367–374.
3. van der Velden EM, de Jong BD, van der Walle HB, Stolz E, Naafs B. Tattooing and its medical aspects. *Int J Dermatol* 1993; 32:381–384.
4. Nag S, McCulloch A. An informative tattoo. *Postgrad Med J* 2003; 79:402.
5. Aldasouqi S. A medical alert tattoo. *Am Fam Physician* 2011; 83:796.
6. Barclay P, King H. Tattoo medi-alert. *Anaesthesia* 2002; 57:625.
7. Wolf EK, Laumann AE. The use of blood-type tattoos during the Cold War. *J Am Acad Dermatol* 2008; 58:472–476.
8. Lawn A, Bassi D. An unusual resuscitation request. *Resuscitation* 2008; 78:5–6.
9. Gupta D. Tattoo flash: consider “do not resuscitate.” *J Palliat Med* 2010; 13:1155–1156.
10. Sullivan W. The “emergency” DNR order. *ED Legal Letter* 2005; 16:133–144.
11. Polack C. Is a tattoo the answer? *BMJ* 2001; 323:1063.
12. Sokol DK, McFadzean WA, Dickson WA, Whitaker IS. Ethical dilemmas in the acute setting: a framework for clinicians. *BMJ* 2011; 343:d5528.
13. Cooper L, Aronowitz P. DNR tattoos: a cautionary tale. *J Gen Intern Med* 2012; E-pub ahead of print.
14. Iserson KV. The ‘no code’ tattoo—an ethical dilemma. *West J Med* 1992; 156:309–312.
15. Kämäräinen A, Länkimäki S. A tattooed consent for organ donation. *Resuscitation* 2009; 80:284–285.
16. Chen SG, Chiu TF, Su WF, Chou TD, Chen TM, Wang HJ. Nipple-areola complex reconstruction using badge flap and intradermal tattooing. *Br J Surg* 2005; 92:435–437.
17. Hoffman S, Mikell A. Nipple-areola tattooing as part of breast reconstruction. *Plast Surg Nurs* 2004; 24:155–157.
18. Goh SC, Martin NA, Pandya AN, Cutress RI. Patient satisfaction following nipple-areolar complex reconstruction and tattooing. *J Plast Reconstr Aesthet Surg* 2011; 64:360–363.
19. van der Velden EM, Baruchin AM, Jairath D, Oostrom CA, Ijssemluiden OE. Dermatology: a method for permanent repigmentation of achromic burn scars. *Burns* 1995; 21:304–307.
20. Traquina AC. Micropigmentation as an adjuvant in cosmetic surgery of the scalp. *Dermatol Surg* 2001; 27:123–128.
21. Whitton ME, Pinart M, Batchelor J, Lushey C, Leonardi-Bee J, González U. Interventions for vitiligo. *Cochrane Database Syst Rev* 2010; 1:CD003263.
22. Singh AK, Karki D. Micropigmentation: tattooing for the treatment of lip vitiligo. *J Plast Reconstr Aesthet Surg* 2010; 63:988–991.
23. Pitz S, Jahn R, Frisch L, Duis A, Pfeiffer N. Corneal tattooing: an alternative treatment for disfiguring corneal scars. *Br J Ophthalmol* 2002; 86:397–399.
24. Kim C, Kim KH, Han YK, Wee WR, Lee JH, Kwon JW. Five-year results of corneal tattooing for cosmetic repair in disfigured eyes. *Cornea* 2011; 30:1135–1139.
25. Spyropoulou GA, Fatah F. Decorative tattooing for scar camouflage: patient innovation. *J Plast Reconstr Aesthet Surg* 2009; 62:e353–e355.
26. De Cuyper C. Permanent makeup: indications and complications. *Clin Dermatol* 2008; 26:30–34.
27. Wenzel SM, Welzel J, Hafner C, Landthaler M, Bäuml W. Permanent make-up colorants may cause severe skin reactions. *Contact Dermatitis* 2010; 63:223–227.
28. Wexner SD, Cohen SM, Ulrich A, Reissman P. Laparoscopic colorectal surgery—are we being honest with our patients? *Dis Colon Rectum* 1995; 38:723–727.
29. ASGE Technology Committee; Kethu SR, Banerjee S, Desilets D, et al. Endoscopic tattooing. *Gastrointest Endosc* 2010; 72:681–685.
30. Yeung JM, Maxwell-Armstrong C, Acheson AG. Colonic tattooing in laparoscopic surgery—making the mark? *Colorectal Dis* 2009; 11:527–530.
31. Rockey DC, Paulson E, Niedzwiecki D, et al. Analysis of air contrast barium enema, computed tomographic colonography, and colonoscopy: prospective comparison. *Lancet* 2005; 365:305–311.
32. Starkie A, Birch W, Ferlini R, Thompson TJ. Investigation into the

- merits of infrared imaging in the investigation of tattoos postmortem. *J Forensic Sci* 2011; 56:1569–1573.
33. **Mallon WK, Russell MA.** Clinical and forensic significance of tattoos. *Top Emerg Med* 1999; 21:21–29.
 34. **Lessig R, Grundmann C, Dahlmann F, Rätzcher K, Edelmann J, Schneider PM.** Review article: Tsunami 2004—a review of one year of continuous forensic medical work for victim identification. *EXCLI* 2006; 5:128–139.
 35. **Sutherland C, Groombridge L.** The Paddington rail crash: identification of the deceased following mass disaster. *Sci Justice* 2001; 41:179–184.
 36. **Sperry K.** Tattoos and tattooing. Part II: gross pathology, histopathology, medical complications, and applications. *Am J Forensic Med Pathol* 1992; 13:7–17.
 37. **Jacob CI.** Tattoo-associated dermatoses: a case report and review of the literature. *Dermatol Surg* 2002; 28:962–965.
 38. **Kaur RR, Kirby W, Maibach H.** Cutaneous allergic reactions to tattoo ink. *J Cosmet Dermatol* 2009; 8:295–300.
 39. **Reddy KK, Hanke CW, Tierney EP.** Malignancy arising within cutaneous tattoos: case of dermatofibrosarcoma protuberans and review of literature. *J Drugs Dermatol* 2011; 10:837–842.
 40. **Price RR.** The AAPM/RSNA physics tutorial for residents. MR imaging safety considerations. *Radiological Society of North America. Radiographics* 1999; 19:1641–1651.
 41. **Franiel T, Schmidt S, Klingebiel R.** First-degree burns on MRI due to nonferrous tattoos. *AJR Am J Roentgenol* 2006; 187:W556.
 42. **Chikkamuniyappa S, Sjuve-Scott R, Lancaster-Weiss K, Miller A, Yeh IT.** Tattoo pigment in sentinel lymph nodes: a mimicker of metastatic malignant melanoma. *Dermatol Online J* 2005; 11:14.
 43. **Morte PD, Magee LM.** Hyperalgesia after volar wrist tattoo: a case of complex regional pain syndrome? *J Clin Neuromuscul Dis* 2011; 12:118–121.
 44. **Kennedy BS, Bedard B, Younge M, et al.** Outbreak of *Mycobacterium chelonae* infection associated with tattoo ink. <http://www.nejm.org/doi/full/10.1056/NEJMoa1205114?query=TOC#t=article>. Accessed August 28, 2012.

.....
ADDRESS: Crystal Marie Glassy, DO, MPH, 13340 Caminito Ciera #43, San Diego, CA 92129; e-mail glassyc@gmail.com.