A qualitative study on the rejection reaction of human skin to metal

Wen-Tian Lyu

Department of Oncology, Wuhan No.5 Hospital, Wuhan, Hubei 430050, China.

To the Editor: Human skin is not only a physical barrier that prevents the invasion of foreign substances, it is also a biological barrier that mounts immune responses to pathogenic microorganism, exogenous macromolecular substances, allograft, and so on.[1] For exogenous skin graft, the immune system-recognized target is the exogenous cell-derived major histocompatibility complex (MHC) class-1 molecule, along with the peptide-MHC class 1 complex.[2] All exogenous substances known to be rejected by skin are organic; it remains unclear whether human skin has a rejection to inorganic substances. The author noticed the phenomenon in his own experience that a metal particle residing under his foot skin was discharged by the skin. Notably, the skin was intact before eliminating the metal. Thus, the author further investigated this process.

When the author was 15 years old, his left foot suddenly bled one day while he was hammering a piece of metal. He felt no pain or foreign body sensation. Several weeks later, the metal particle was visible as a black small object residing under the skin at a different locus from the metal entry point. The author was unable to feel the metal until he touched the metal enwrapped by the skin 7 years later. When he was 43 years old, he noticed one day that a corroded metal particle had spontaneously appeared on the surface of the skin through a fistula [Figure 1A]. Through years of research on foot skin and foot magnetic resonance imaging (MRI), the author is trying to figure out the nature of this phenomenon.

According to the author, the skin adjacent to the metal particle was intact and movable before the metal particle was eliminated. At the time when the metal particle was discharged from the foot, a corroded metal particle with 5-mm diameter was eliminated from a fistula, which was soon healed. The metal entry position was visible as a 10-mm scratch, indicating the incident trajectory of the metal. The metal exit and entry points were 7 mm apart from each other [Figure 1A–1H]. Three years after the discharge of the iron particles, both the T1 and T2 phases of an MRI of the left foot revealed a fistula that originated from the space between skin and muscles, located within the skin of the foot dorsum, adjacent to the tibialis anterior muscle. The MRI T1 phase revealed that the fistula length was 10 mm. The T2 phase showed that the skin thickness was no more than 5 mm [Figure 1I–1N].

There are two key questions in this study that need to be addressed. First, where was the metal particle located after being shot into the skin? Second, is this rejection due to a skin physiological function? Regarding the first issue, the foot skin, which was measured to be no more than 5 mm thick, consists of epidermis, dermis, and subcutaneous tissue (fat tissue)[3,4] and is rich in nerve endings and capillaries. Thus, any foreign substance embedded in the skin should lead to symptoms like swelling, pain, and the sensation of a foreign body, and further cause skin inflammation and necrosis. However, the author had not experienced any such symptoms for nearly 30 years. Furthermore, the diameter of the metal in this study is similar to the thickness of the foot skin. Thus, it was not possible for the metal to be embedded in the skin without poking out. The findings here suggest that the metal particle resided in the space between skin and muscles of the foot dorsum.

Regarding the second question, there are two prerequisites to judging whether this rejection was derived from a physiological function. First, the skin near the metal foreign body must be intact. Second, the metal foreign body must not exert its stimulating effect by causing skin damage or infection, or else the rejection falls within the field of pathophysiology. For example, Keum *et al*[5] reported a facial skin rejection to needles; however, because the needle tips provided stimulation, the possibility that the metal rejection was the result of pathophysiology could not be ruled out. In contrast, the rejection process in the present study has been shown to meet both these prerequisites.

The process of this rejection may have unfolded as follows: about 30 years ago, an iron particle was shot into the skin, causing a 10-mm scratch, and stopping in the space

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Correspondence to: Dr. Wen-Tian Lyu, Department of Oncology, Wuhan No.5 Hospital, No.122 Xianzheng Street, Wuhan, Hubei 400300, China
E-Mail: lwt2879@163.com

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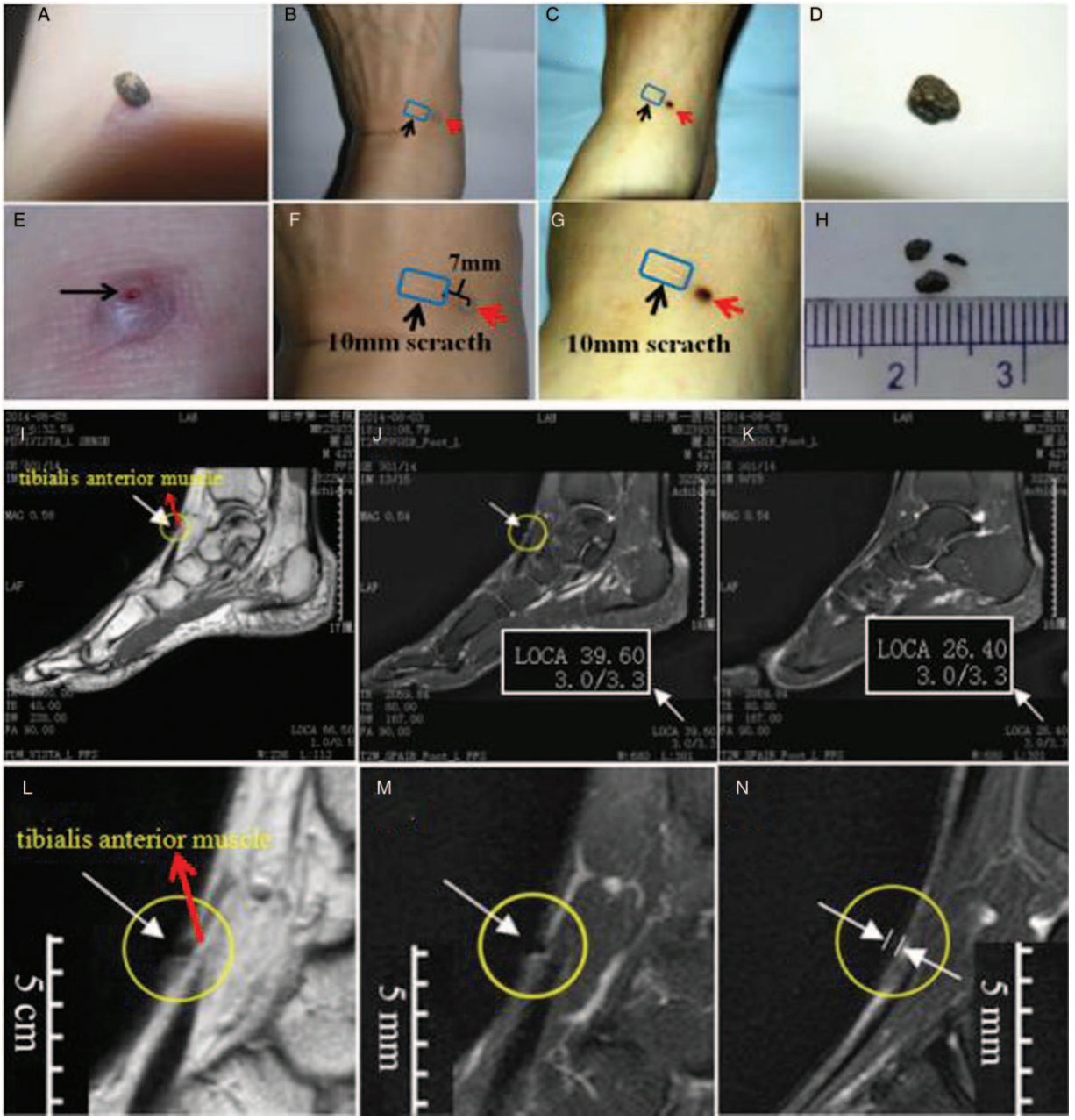

Figure 1: Photographs of (A) the metal particle being spontaneously discharged from a fistula; the foot at the 7th day (B) and 6th month (C) after eliminating the metal. The black arrow pointing to the blue box indicates the 10-mm scratch at the metal entry site. The white spot (red arrow) indicates the exit point from the fistula. (D) shows the largest diameter of corroded metal particle is about 5 mm; (E) shows the fistula (black arrow). (F) Is the close-up of (B), in which the scratch edge is seen 7 mm from the white spot, and (G) is the close-up of (C). (H) Shows the pieces into which the particle spontaneously broke. (I–N) MRI of the patient's left foot. (I) T1 phase, (J, K) T2 phase. The length of the fistula is about 1 cm (I, J). (K) The section next to that shown in (J). The MRI scanning thickness is 3 mm, which is shown in the white square pointed by the white arrow in (J) and (K). (L–N) are the close-ups of I–K, respectively. The white arrow in the yellow ring indicates the fistula in (I, J, L, M) and the red arrow indicates the tibialis anterior muscle in (I, L). The yellow ring indicates the area in which the target is located in (I, J, L, M, N). The two white arrows in the yellow ring show the skin thickness which is <5 mm (N). MRI: Magnetic resonance imaging.

between the skin and the tibialis anterior muscle, 7 mm from the entry site. Over time, the metal became enwrapped by skin, then moved towards the skin surface and was eliminated through a spontaneously formed fistula.

This rejection took several decades. The results are difficult to verify in animal experiments. Such a special process must be correlated with a unique physiological function of the skin, that is, the function of skin to reject metal. The details of this rejection reaction, that is, the mechanism by which the skin was able to wrap around the metal and spontaneously form a fistula to expel the metal out of the body, are unclear and remain to be further explored.

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Conflicts of interests

None.

References

1. Zhou J, He W, Luo G, Wu J. Fundamental immunology of skin transplantation and key strategies for tolerance induction. Arch Immunol Ther Exp (Warsz) 2013;61:397–405. doi: 10.1007/s00005-013-0233-2.
2. Phillips BL, Callaghan C. The immunology of organ transplantation. Surgery (Oxford) 2017;35:333–340. doi: 10.1016/j.mpsur.2017.04.004.
3. Lacouture ME. Dermatologic principles and practice in oncology. In: Lacouture ME, ed. Conditions of the Skin, Hair, and Nails in Cancer Patients. New Jersey: John Wiley & Sons, Inc; 2014:24–25.
4. Solomon EP. Introduction to Human Anatomy and Physiology. 4th ed. In: Solomon EP, ed. Philadelphia: Elsevier Saunders; 2015:44–46.
5. Keum DI, Bak H, Ahn SK. Transepidermal elimination of gold metals after face-lifting acupuncture. Ann Dermatol 2016;28:501–502. doi: 10.5021/ad.2016.28.4.501.

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