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Enhanced immunity in intradermal vaccination by novel hollow microneedles

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Background & Objective: We have developed a new device with multiple fine needles fabricated with a bevel angle to release a drug broadly and homogeneously into the skin in a horizontal fashion and reported in the article. It led us to develop another type of multiple needles to release a drug in the epidermis or upper dermis. The intradermal (ID) route for vaccination represents an effective alternative to subcutaneous (SC)/intramuscular administration to induce protective immunity. However, a critical issue associated with ID vaccination is the precise delivery of solution in the upper dermis, which ensures enhanced immunity.

Methods: We fabricated a hollow microneedle unit made of poly-glycolic acid by injection molding and bonding and developed a dedicated prototype injector. To ensure ID delivery of solution, the injected site was macroscopically and microscopically examined. Serum immunoglobulin G antibody production was measured by enzyme immunoassay and compared in groups of rats following either ID delivery with microneedles or SC administration with a 27-G stainless needle of graded vaccine doses.

Results: The unit used a tandem array of six microneedles, each with a side delivery hole, and a conduit inside for solution. Microneedles installed in the injector punctured at the skin with the aid of a spring. Injection of solution formed a wheal due to ID distribution. Histologically, a wedge-shaped skin defect in the upper skin corresponded to each puncture site. Antibody titers following vaccinations on days one and eight were significantly higher with ID injection than with SC delivery on day 15 and every seven days, thereafter until day 36 with mumps vaccination, and until day 36 with varicella vaccination.

Conclusions: The microneedle unit presented here delivered solution intradermally without any difficulty and evoked antibody responses against viruses even with the reduced vaccine volume. Our findings confirm promising results of ID delivery as an immunogenic option to enhance vaccination efficacy.

Biography

Hidekazu Fukamizu is the Director of Department of Plastic and Reconstructive Surgery, Hamamatsu University School of Medicine. He published few articles on drug delivery in the following journals: “Development of three-microneedle device for hypodermic drug delivery and clinical application” in Plastic and Reconstructive Surgery, 2012; “Application of a three-microneedle device for the delivery of local anesthetics” in Patient Preference and Adherence, 2015.

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