

NEWS & VIEWS: RECENT PATENTS IN ALLERGY AND IMMUNOLOGY

Allergy...No more fear of needles!

Abstract

Needleless injection systems are nowadays widespread and are mainly used to overcome the common problems of needle injection systems, such as pain, hematoma, scar tissue formation, infection or abscess, possibility of accidentally injecting into a venous vessel, and transmission of infectious diseases. All these problems are independent of the type of drug injected and are exclusively related to the needle devices. Current needleless injection systems are a valuable tool, which is especially available for the administration of vaccines to large numbers of patients. Our experience focused in particular on the so-called "jet injectors," of which one of the most valid representatives is Injex®. Our patent essentially concerns a medical needleless device, suitable to inject a subcutaneous AIT (allergy immunotherapy). The mechanism at the base of our device works with compressed air by means of a spring: It is very simple and similar to that of compressed air guns. Once the syringe has been filled, it is placed perpendicular to the skin, and then, the device is activated. The pressure vaporizes the drug, without changing or altering its chemical structure; it makes it pass through the epidermis, until it quickly reaches the subcutaneous layer, at a depth between 3.2 and 9.1 mm, without the patient feeling any pain. The entrance hole made by the needleless device in the epidermis is 0.17 mm rather than 0.39 mm of a normal needle. This type of administration also allows a uniform and spray diffusion of the drug, without causing localized inflammation, as it sometimes happens with normal syringe.

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about 150 mt/s. The ampoule containing the vaccine is placed in the front part of the device body, and for a correct administration, it must perfectly adhere to the skin. This is the only way to ensure that the liquid reaches the optimal depth into the subcutaneous tissue, between 5.1 ± 1.8 mm. The use of the common syringe with a 13-mm needle does not give this guarantee, while the Injex® device does. However, the latter still depends on the ability of the operator, since a certain skill is required to guarantee constant pressure and inclination. Thanks to the electronic sensors placed in the front ring surrounding the ampoule (Figure 1); our device is independent of the operator: It guarantees the absolute reproducibility of these parameters and therefore the correct delivery of the vaccine to a depth between 3.2 and 9.1 mm. The pressure vaporizes the drug, without changing or altering its chemical structure; it makes it pass through the epidermis, until it quickly reaches the subcutaneous layer, without the patient feeling any pain. The entrance hole made by the needleless device in the epidermis is 0.17 mm rather than 0.39 mm of a normal needle. This type of administration also allows a uniform and spray diffusion of the drug, without causing localized inflammation, as it sometimes happens with normal syringes, and above all it permanently eliminates the risk of inoculation in the bloodstream and of contamination with potentially infected blood. Furthermore, even after repeated administrations, the occurrence of subcutaneous lipodystrophies was not recorded. There is no possibility of contamination between the content of the ampoule and the device. The

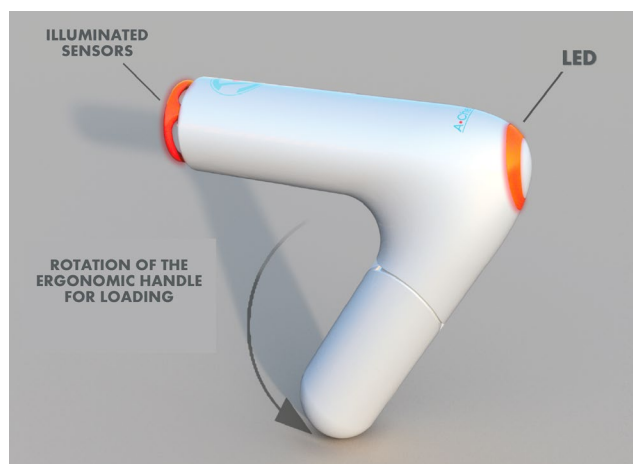


FIGURE 1 The automatic chec jet device. Extending the ergonomic handle loads the device

[Correction added on 6 August 2019, after first online publication on 29 July 2019: the affiliations for authors Alberto G. Martelli and Alessandro Giovanni Fiocchi have been corrected in this version]

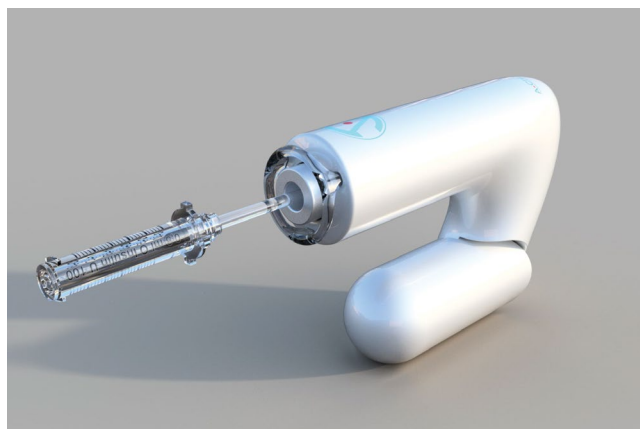


FIGURE 2 Placement of the already filled syringe

most important and delicate aspect of this type of devices is the correct adherence of the ampoule that contains the vaccine to the skin tissue. Without a perfect adherence, the pressure would be dispersed and the still liquid drug would not penetrate correctly in the subcutaneous area. Other devices, mainly dedicated to the administration of insulin, vaccines, anesthetics, and hormones (such as growth hormone), have encountered these difficulties. This has highlighted the importance of the need for inoculation in the subcutaneous tissue to obtain the desired effect, avoiding penetration into the dermis, the muscle, blood vessels, or even in the peritoneum, in order not to affect the absorption or even promote adverse events.¹ Besides a careful study of materials and ergonomics in order to eliminate possible pathologies of the wrist related to prolonged use, one of the peculiarities of our needleless device certainly consists in the presence of three barometric sensors with inclinometer in the front ring of the instrument (Figure 2). These sensors are connected to an electronic circuit, whose software has preset values of pressure and inclination. When the correct values are reached, a clearly visible LED switches from red to green light and the shooting is possible. This procedure allows a fast, precise, and above all safe shooting. In Italy, the use of the AIT and needleless device patent is already underway and we expect to be able to extend it soon to other European countries. We hope thus to be able to implement the use of AIT and in particular of subcutaneous allergen immunotherapy, which remains the gold standard of this allergic treatment. This idea was born about 10 years ago when Dr Mario Mancini, co-inventor with the undersigned, was looking for a needleless device to be used for subcutaneous injections for aesthetic purposes. We studied the existing mechanisms and their possible applications. Hence, the idea of using this device also for subcutaneous allergen immunotherapy and the subsequent birth of our *dream team* with Prof. Riccardo Polosa and Dr Massimo Caruso, University of Catania, Prof. Alessandro Fiocchi, Bambino Gesù Hospital in Rome and Dr Alberto Martelli, Guido Salvini Hospital in Garbagnate Milanese. In 2014, the utility model (no 0000277574) was registered in Italy for the application of the needleless device to AIT. Afterward, in 2017, we registered the

international patent no PCT/IT2016/000123. In the same year, our *dream team* conducted the first two clinical trials on subcutaneous allergen immunotherapy and the Injex® device. The studies were conducted on 30 adult patients and 39 pediatric patients, and were aimed at verifying the safety, tolerability, and effectiveness of the device. Besides, the study conducted on adults successfully verified the correct basophil activation. For both studies, an allergoid for grass pollen was used in patients with allergic rhinitis with or without bronchial asthma.⁶ The positive results of these studies were presented at several international conferences and are currently being published.⁷⁻⁹

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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