IONTOPHORESIS: NONINVASIVE DRUG DELIVERY AND CLINICAL CHEMISTRY VIA THE SKIN

Richard H. Guy

School of Pharmacy, University of Geneva, Switzerland

At the time of writing, the renaissance of interest in iontophoresis, manifest during the past 15 years, has yet to realize a significant impact upon the transdermal technology market. Regrettably, many of the drug delivery problems examined initially with iontophoresis could have been predicted as failures (e.g., insulin)[1] and should probably never have been attempted; in general, one can say that, in many cases, the "bar was set too high". With the benefit of this hindsight, however, and the lessons learned over time, the field is now set to "deliver" its first, integrated products and to offer a more logical basis for the future application and development of this technique.

One may cite three examples of the technology which are now mature. With respect to drug delivery, iontophoretic systems containing lidocaine[2], for the rapid induction of local anesthesia, and fentanyl[3], for the relief of severe pain, have reached advanced clinical testing in the U.S.A., and have the potential to reach the market within the near future. Recently approved by the FDA (and having already received the CE mark in Europe) is the "Glucowatch"®, an iontophoretic device, not for drug delivery, but rather for the noninvasive extraction and subsequent determination *in situ* of the level of glycemia in diabetics[4].

The science of iontophoresis, and its mechanistic understanding, in particular, has also matured considerably, such that optimization of the method for noninvasive drug delivery and clinical chemistry applications can now be envisaged. The potential of the approach in areas not yet explored in great detail, such as photodynamic therapy and therapeutic drug monitoring, as well as the technological barriers remaining to be resolved, merit a critical and comprehensive evaluation.

Iontophoretic research in my laboratory is supported by the Fonds national suisse de la recherche scientifique and by the Program commun de recherche en génie biomédical (1999-2002) of the Universities of Geneva and Lausanne, the Ecole Polytechnique Fédérale (Lausanne), and the university hospitals of the cantons of Geneva and Lausanne. The continued efforts of my research colleagues in Archamps is gratefully acknowledged.

1. Sage B. Insulin iontophoresis. In: *Protein Delivery – Physical Systems*. Edited by Sanders LM, Hendren RW. Plenum, New York, 1997, pp. 319-341.
2. http://www.bd.com/pharmaceuticals/products/transdermal/safety.html
3. Gupta SK, Sathyan G, Phipps B, Klausner M, Southam M. Reproducible fentanyl doses delivered intermittently at different time intervals from an electrotransport system. *J. Pharm. Sci.* 1999, **88**: 835-841
4. http://www.cygn.com/glucowatch.html