The Impact of Insulin Adsorption onto the Infusion Sets in the Adult Intensive Care Unit

Therese Jakobsson, M.Pharm.Sci.,[1] Robert Shulman, D.H.C. (Pharm.),[2] Hardyal Gill, Ph.D.,[3] Kevin Taylor, Ph.D.[3]

The difficulty in achieving tight glycemic control (TGC)[1,2] in the adult intensive care unit (ICU) is well documented.[3,4] We aimed to explore the impact of insulin adsorption onto infusion sets in the laboratory and to assess retrospectively if higher insulin doses are required after syringe changes in practice in the ICU. Adsorption is reported to occur predominantly during the first hour of infusion, after which binding sites are saturated.[5] There is greater insulin recovery with faster flow rates and higher insulin concentration.[6] The clinical significance of such adsorption in the ICU setting is uncertain.[5]

In our study—approved by the local ethics committee—adsorption of insulin onto the giving sets used in our adult ICU was analyzed. The infusion set used was a 50 ml polypropylene syringe (BD Plastipak®) and 1.6 ml/200 cm polyethylene (PE) tubing (Cardinal Health, extension set). In the laboratory, the concentration investigated was 1 U/ml of neutral insulin in sodium chloride 0.9%. The concentrations were determined using a high-performance liquid chromatography method with a Jupitor 300, 5 μm C18, 250 mm x 4.6 mm column (Phenomenex), a mobile phase of 30% acetonitrile and 0.1% TFA in water, and ultraviolet detection at 210 nm. Significant insulin adsorption of 10% occurred during the first hour of an infusion when the infusion rate was 1 ml/h (Figure 1). Our experience suggests that this is a common infusion rate used in intensive insulin therapy. No significant adsorption occurred when the infusion rate was 4 ml/h, although a trend could be seen with solution leaving the PE tubing at the beginning of the time period having a lower insulin concentration, which increased with time.

The infusion rates used before and after an infusion set change were investigated for 17 ICU patients known to have been managed with a TGC protocol, aiming for glycemia of 4.4–6.1 mmol/liter, to examine any relationship between the duration of usage of the infusion set and the variation in insulin dosing required. These patients were not prescribed drugs known to affect glucose control, such as inotropes and corticosteroids. In the ICU patients, a significantly higher insulin infusion rate was required after an infusion set change when the infusion rate was 1 ml/h or lower. After an infusion set change, the rate was adjusted upward in 76.5% of cases.

Author Affiliations: [1]Uppsala University, Uppsala, Sweden; [2]Pharmacy Department, University College London Hospitals NHS Foundation, London Trust, London, UK; and [3]Department of Pharmaceutics, School of Pharmacy, University of London, London, UK

Abbreviations: (ICU) intensive care unit, (PE) polyethylene, (TGC) tight glycemic control

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Corresponding Author: Robert Shulman, D.H.C. (Pharm.), Pharmacy Department, University College London Hospitals NHS Foundation, London Trust, 235 Euston Road, London, NW1 2BU; email address robert.shulman@uclh.nhs.uk

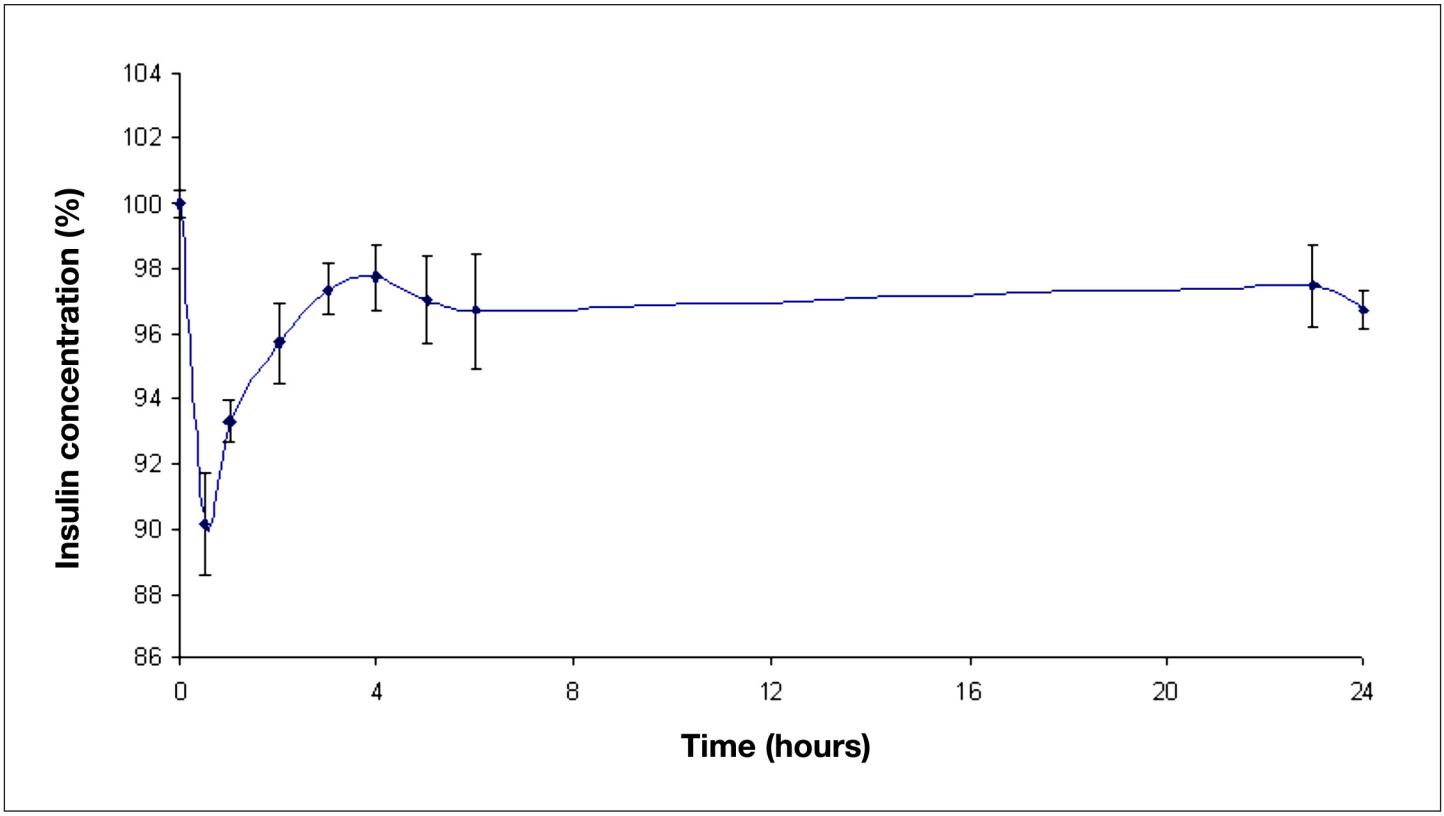

Figure 1. The mean (± standard error) insulin concentration versus time with an infusion rate of 1 U/h.

In conclusion, we found in the laboratory that less insulin is delivered during the first three hours after an infusion set change, when the infusion rate is 1 ml/h or lower, due to adsorption onto infusion sets. In the ICU, a higher infusion rate was frequently required after an infusion set change when the infusion rate was 1 ml/h or lower. Our results indicate that at low infusion rates, if the syringe and line are not primed, only 90% expected insulin is delivered. The clinical impact of a loss of 0.1 U/h of insulin is questionable, but in practice when syringes were changed, higher rates were frequently required. Further investigation should be undertaken to confirm these findings.

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