

50. Improved pharmacokinetic and pharmacodynamic profile of rapid-acting insulin using needle-free jet injection

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Background

Current insulin jet injectors use a high-velocity jet to deliver insulin into the subcutaneous region without penetrating the skin with a needle. The scattered pattern of insulin dispersion in the subcutaneous space after jet injection may facilitate its subsequent absorption into the circulation. This study evaluated the pharmacokinetic and pharmacodynamic profiles of rapid-acting insulin when injected with needle-free jet injection.

Methods

glucose clamp tests were performed in 18 healthy volunteers (M/F 5/13; age 27 ± 9 years, BMI 23.6 ± 2.8 kg/m²) after subcutaneous administration of rapid-acting insulin (aspart) either by jet injection or by conventional insulin pen injection, using a double-blind, double-dummy cross-over study design. Insulin was injected in the abdominal region in a dose of 0.2 units per kg body weight. Pharmacodynamic and pharmacokinetic profiles were derived from the glucose infusion rate (GIR) to maintain euglycaemia and from plasma insulin measurements, respectively.

Results

Pharmacodynamic data revealed that the time to maximal GIR was significantly shorter when insulin was injected with the jet injector compared to the conventional pen

(51 ± 3 versus 105 ± 11 min, $p = 0.0001$, see figure). There was no difference in the maximal GIR between the two modes of insulin administration (6.49 ± 0.58 versus 6.09 ± 0.56 mg/kg/min, $p = 0.50$), but the duration of the glucose lowering effect as reflected by the time of 50% glucose disposal was shorter with the jet injector (123 ± 7 versus 166 ± 6 min, $p < 0.0001$). Pharmacokinetic data showed that the time to peak insulin concentration was shorter (31 ± 3 versus 64 ± 6 min, $p < 0.0001$) and the maximal insulin concentration was higher (108 ± 13 versus 79 ± 7 mU/l, $p = 0.01$) when insulin was injected with the jet injector compared to conventional pen injection. There were no differences in the total amount of insulin absorbed or the total amount of glucose infused between the two insulin delivery systems. Effects were similar among men and women and were not modified by age.

Conclusion

Insulin injected by jet injection results in faster insulin absorption and higher insulin peak levels as well as faster onset and shorter duration of glucose-lowering action compared to conventional insulin administration. Thus, the pharmacological profile of insulin administered by jet injection better resembles the profile of endogenous insulin secretion than that of insulin injected by conventional pens.

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Figure 1: Glucose infusion rates during the euglycaemic clamp.

