Abstract: Optimal blood glucose control and the restoration of the physiological insulin secretion is a current medical challenge and will account for an overall cardiovascular morbidity and mortality related to diabetes mellitus complications. Continuous Subcutaneous Insulin Infusion (CSII) is the first step to the development of the so-called “artificial pancreas” and is intended to restore blood glucose levels and the frequency of hypoglycemic episodes. CSII using an external pump, offers both a better glycemic profile compared to multiple daily insulin injections (MDI) and a broader flexibility in everyday activities. The advantages of insulin pumps, i.e., basal delivery consistency, adjustable basal rates and low insulin depots also contribute to its reported clinical superiority. However, experience with CSII indicates that candidate patients should be carefully selected, thoroughly educated and vividly motivated to improve their blood glucose control.

INTRODUCTION

Diabetes mellitus (DM) has been one of the primary causes of increased cardiovascular morbidity and mortality and constitutes a large burden to health care systems in terms of both direct and indirect costs. Currently, it is manageable via constant vigilance, although the majorities of patients fail to sustain long-term, adequate control through lifestyle modifications or even combined oral medications (biguanides, sulfonylureas, meglitinides, glitazones, incretin mimetics, or DPP-4 inhibitors). Indeed, multidrug therapy schemes are currently reconsidered, since recent studies question the ratio of long-term therapeutic benefit over side effects or disease complications. In addition, chronic elevations and
fluctuations of blood glucose are associated with long-term complications (blindness, kidney failure, heart disease and lower extremity amputations), while tight glucose control increases the risk of serious hypoglycemia. Therefore, efficient glucose control (attainment of normal HbA1c, prandial and postprandial glucose levels) is absolutely essential to the prevention of life-threatening complications of the disease.1-4

The above-described interactions have led to the development of continuous subcutaneous insulin infusion (CSII) pumps and short acting insulin analogues exhibiting beneficial pharmacokinetic properties, which control glycemic variability, which is an independent risk factor for diabetic complications.

BASIC CHARACTERISTICS OF INSULIN PUMPS

CSII with portable pumps was introduced in 1976 by Pickup and Keen for research purposes and have been commercially available since. The initial pumps developed had the size of a back bag but the progressive improvements in software features had led to both pumps and infusion sets size minimization.5 A typical insulin pump consists of the main device that includes a disposable reservoir for insulin (usually 300 units), an insulin promotion mechanism capable of different flow rates, a processing module (micro-computer), which carries out the installed program and batteries. The external part is the infusion set, including a cannula for subcutaneous insertion and a tubing system to interface the insulin reservoir to the cannula. Newer pumps (a “patch” or “pod” pump) eliminate the need for infusion set tubing and manual insertion of the infusion set catheter.6 Modern pump software calculates different carbohydrate to insulin ratios and insulin sensitivities variations so as to automatically correct doses throughout the day. Some of them may also calculate residual insulin activity following an insulin bolus. Most pumps receive data radio frequencies or built-in glucose meters, so as glucose values are automatically entered.7

A well-educated diabetic user can achieve a very efficient glycemic control by monitoring blood glucose frequently, adjusting insulin doses based on an accurate assessment of the quantity and type of meals consumed and compensate for the effect of physical activity on glucose levels. Table 1 summarizes current indications and contradictions of insulin pump therapy.

The main problems of insulin pump therapy refer to undermedication or overmedication due to malfunction and/or improper use. Device problems may include alarm problems, loosening and/or occlusion of the catheters, bent cannula and screen display problems. While infusion-site infections are uncommon, irritation or inflammation at the infusion site is pretty common while using an insulin pump, though their incidence has been reduced by the introduction of more modern infusion sets (e.g., sets with a Teflon cannula) and by more sufficient patient education.8

CLINICAL EFFICACY AND SAFETY

Regarding CSII clinical efficacy, several studies have shown its clinical superiority over multiple daily insulin injections (MDI) in terms of HbA1c control and have also concluded that CSII, using rapid-acting analogs, is more beneficial in controlling postprandial hyperglycemia and HbA1c than CSII using regular human insulin.9,10