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Review Article

REVIEW ARTICLES

Clinical recommendations in the management of the patient with type 1 diabetes on insulin pump therapy in the perioperative period: a primer for the anaesthetist

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Abstract

Insulin pump therapy is increasingly common in patients with type 1 diabetes. Many of these patients will require surgery at some point in their lifetime. Few doctors will have experience of managing these patients, and little evidence exists to assist in the development of guidelines for patients with insulin pump therapy, undergoing surgery.

It is clear that during emergency surgery insulin pump therapy is not appropriate and should be discontinued, but patients undergoing some elective surgery can and should continue insulin pump therapy, without any adverse effect on their blood sugar control, or on the outcome of their surgery. Individual hospitals need to formalize guidance on the management of patients receiving continuous subcutaneous insulin therapy, to allow patients the choice to continue their therapy during surgery. This expert opinion presents anaesthetists with a suggested clinical framework to help facilitate continued insulin pump therapy, during elective surgery and into the postoperative period.

Key words: diabetes mellitus, type 1; insulin infusion systems; surgery

Since its introduction in the 1970s insulin pump therapy is being used increasingly in the management of type 1 diabetes, with current estimates of between 20 to 30% of people in North America with type 1 diabetes being pump users,[1 2] and this number is increasing rapidly in the UK. Current NICE guidance in the UK recommends 15–20% of the population with type 1 diabetes should be eligible for insulin pump therapy. However, uptake remains very dependent on individual diabetes centres having sufficient expertise in this technology, and it remains a postcode lottery.[3 4] Original studies of continuous subcutaneous insulin infusion (CSII), compared patient groups randomized to either multiple daily injections (MDI) or insulin pump therapy. The initial studies using older non-analogue based insulin regimens, demonstrated improvements in glycaemic control, with reductions in HbA1c and hypoglycaemia with insulin pump therapy.[5] These results were later confirmed using newer basal insulin analogues[6] and were demonstrated with an associated improved quality of life in both adults and children.[7] After publication of the results from the seminal Diabetes Control and Complications Trial (DCCT) in 1993, care for people with type 1 diabetes has focused on aiming to achieve intensive management of glucose control, hence reducing micro- and macrovascular risk.[8] Insulin pump therapy has been demonstrated to reduce HbA1c significantly over MDI in the first year of use in numerous studies[9 10] and we are now starting to see multicenter long-term outcome data, demonstrating similar results over 1–10 yr periods compared with prepump values[11 12] and in comparisons of matched cohorts continuing on MDI.[13]

The primary goal of insulin pump therapy is to mimic physiological insulin replacement, which is missing in people with type 1 diabetes, as a result of the autoimmune destruction of B-cells of the pancreas. It therefore follows that this therapy may also be

considered in people with total pancreatic failure from other causes, such as post total pancreatectomy[14] and pancreatitis although, currently in the UK this does not fall strictly within NICE guidelines.

There has long been interest in using insulin pump therapy in type 2 diabetes, which is characterized primarily by insulin *resistance* rather than insulin *deficiency*. However, pump therapy for type 2 diabetes is not recommended by the UK NICE guidelines, because of a lack of consistent and convincing evidence resulting from a few small scale randomized controlled trials, comparing multiple daily dose insulin to insulin pump therapy.[15 16] The recent large scale OpT2mise study, comparing insulin pump therapy against MDI use in people with type 2 diabetes, only demonstrated a cost-effective benefit from CSII use with a reduction in HbA1c of 1.1%, in those only in the highest tertile of HbA1C at baseline.[17]

Despite significant advances in technologies for diabetes management, insulin pump therapy is not for everyone. There are multiple reasons why pump therapy is not considered appropriate for all, such as visual and cognitive impairment, loss of manual dexterity and infusion site reactions. The use of the pumps during exercise, bathing and intimacy are perceived barriers, although are not usually insurmountable and indeed during sport the pump offers significant advantages, in allowing flexibility of diabetes management.[18] In addition, the psychological burden of being attached to a machine in many patients outweighs benefits and acts as a barrier to adopting CSII.[19] Personal choice also plays a crucial role in deciding on therapy for type 1 diabetes. The interaction between healthcare providers and individuals with diabetes is paramount, in weighing up the pros and cons in opting for insulin pump therapy.

Healthcare professionals from all specialties are increasingly likely to encounter situations where some knowledge of insulin pump therapy is essential. Up to 50% of people with type 1 diabetes are thought to require some form of surgery during their life and so anaesthetists may be required to manage people with type 1 diabetes on CSII through surgery. This article is based on expert opinion and a review of the literature and aims to discuss - for the primary care physician, the anaesthetist, and the surgeon – the general decision-making processes for the management of the patient with type 1 diabetes, on insulin pump therapy, undergoing surgical and investigational procedures. It intends to acquaint the reader with insulin pump mechanics, the language and concepts behind the insulin parameters, and how the pump can fit within the scope of perioperative insulin management, for the patient with ketosis-prone type 1 diabetes.

Most pump users are highly motivated and educated around their diabetes management and are able to manage 'sick day rules' and unforeseen circumstances regarding their blood glucose control. Many will be reluctant to give up this form of therapy whilst being admitted to hospital or undergoing surgery. In these patients it should be possible to continue CSII with prior agreement and shared care between patient, family and healthcare professionals. Insulin pump therapy plays a major role in the self-management skills of diabetes, but under situations where the patient cannot self manage, or that ability is questioned (delirium, pain, medication, loss of consciousness), then management needs to be in the hands of the healthcare team reverting to protocols for the inpatient management of people with type 1 diabetes.[20]

Hospitals need to develop clear protocols for inpatient management of people on insulin pump therapy, with education for all healthcare professionals likely to encounter this technology and close liaison with the diabetes team. However, other than case reports, there is little evidence available to drive recommendations, specifically around pump therapy during surgery and protocols for the management of type 1 diabetes perioperatively, are often not standardized and based on local guidelines rather than national or international standards.[21 22] Other groups have specifically developed guidelines around insulin pump therapy perioperatively,[23 24 25 26] but there is limited evidence on the use of insulin pumps during surgery and a comprehensive set of current best practice recommendations have not been developed. The Joint British Diabetes Society guidelines offer protocols for the management of type 1 diabetes perioperatively and the recommendations here are in alignment with this guidance.[27]

Principles of insulin infusion

The insulin pump is a small, battery-operated, programmable device (Fig. 1) which aims to mimic physiological insulin delivery over 24 h with basal and bolus insulin infusions of rapid acting insulin analogues (Novorapid®, Humalog®, Apidra®). Compared with MDI the pump offers quantitative administration of a basal infusion of insulin, with the capacity for instantaneous change and cessation, tailored bolusing with meals with on board calculators, to maximize dosing accuracy and a convenient method to calculate and administer additional doses of insulin, to correct high

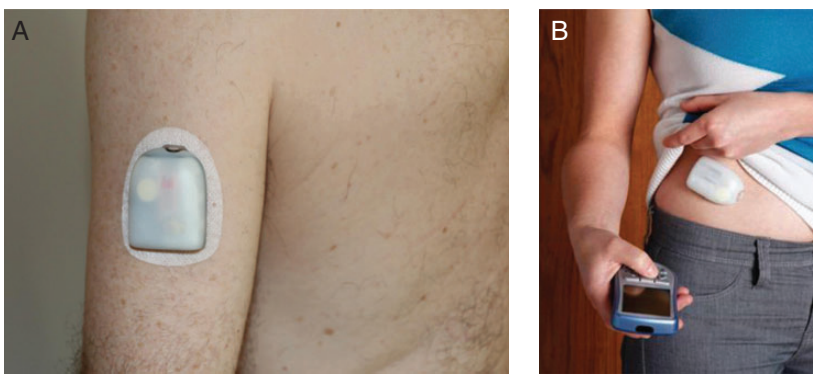

Fig. 1 Examples of Insulin pump systems. (A) A traditional insulin pump with tubing attached directly to the infusion site cannula. (B) A 'patch pump' with a self-contained insulin cartridge in the adhesive pod worn attached to the skin with an integrated subcutaneous cannula and a hand held blue-tooth control device (http://www.designbuzz.com/omnipod-insulin-management-system-living-easier-diabetes/).