

# Can pre-operative carbohydrate loading be used in diabetic patients undergoing colorectal surgery?

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## Abstract

The introduction of enhanced recovery after surgery (ERAS) has been associated with shortening post-operative recovery. It achieves such outcomes by minimizing the physical and physiological trauma of surgery. Benefits include superior pain control, reduced duration of ileus, improved pulmonary function and a reduction in thrombo-embolic and cardiac events. Within the ERAS approach the role of oral carbohydrate supplements is based on dealing with insulin resistance which characterizes periods of stress. Aggressive control of blood glucose levels has been shown to benefit both diabetic and non-diabetic patients admitted to intensive care units, however original studies in this area have not been consistently reproducible. The development of low osmolality carbohydrate drinks during the mid 1990s opened up the possibility of extending these benefits to surgical patients by providing them with a carbohydrate load two to three hours prior to anaesthesia. The benefits of the ERAS approach to colorectal surgery has been confirmed in several reports. However, its role in diabetic patients has, as yet, received limited attention. This review examines this limited number of publications and considers the potential benefit of pre-operative carbohydrate loading in all diabetic patients.

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**Key words:** diabetes, surgery, carbohydrate loading, pre-operative

## Introduction

The introduction of ERAS has been associated with shortening post-operative recovery. It achieves such outcomes by minimizing the physical and physiological trauma of surgery. It is claimed

## Abbreviations and acronyms

ERAS      enhanced recovery after surgery

that such an approach will benefit all patients.<sup>1</sup> The overall strategy requires that patients are given partnership and responsibility for their care, health is optimized prior to surgery and care and rehabilitation are evidence based. Such an approach has called into question the traditional pre-operative overnight fast and the use of bowel preparation for colonic surgery amongst other aspects of care. The benefit of such an approach for patients undergoing colorectal surgery is recognized throughout the world.<sup>1,2</sup> Benefits include superior pain control, reduced duration of ileus, improved pulmonary function and a reduction in thrombo-embolic and cardiac events. Within the ERAS approach the role of oral carbohydrate supplements is based on dealing with insulin resistance which characterizes periods of stress. It improves post-operative glycaemic control through endogenous insulin release, not only by reducing the risk of hyperglycaemia during post-operative nutrition but also by improving nitrogen economy and therefore maintaining muscle strength.<sup>3</sup>

## Historic background

In 1877 Bernard demonstrated that stress disturbed glucose homeostasis when he reported hyperglycaemia in association with haemorrhage.<sup>4</sup> This was the first recognition of the existence of insulin resistance. Although this physiological response in which glucose reserves are directed to non-insulin dependent tissues, such as the brain, may be beneficial after trauma, Ljungqvist *et al.* questioned whether this was true following surgery.<sup>5</sup> These doubts arose following work on insulin resistance as a marker of surgical stress.<sup>6</sup> Elevated blood glucose level is associated with an increased incidence of infections following surgery.<sup>7</sup> Improved glycaemic control was associated with fewer deep sternal infections in diabetic patients who underwent cardiac surgery.<sup>8</sup> Aggressive control of blood glucose levels has been shown to be of benefit to both diabetic and non-diabetic patients admitted to an intensive care unit, with significant reductions in death rates from multiple organ dysfunction.<sup>9</sup> However, since this study was published in 2001, these results have been difficult to reproduce and the NICE-SUGAR study<sup>10</sup> and a meta-analysis<sup>11</sup> have informed consensus opinion that “aggressive” blood glucose control is potentially harmful. The main issue is that an “aggressive” approach to glycaemic control increases

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the likelihood of hypoglycaemic episodes. For this reason moderate control is associated with lower mortality amongst diabetic patients, although this is probably not true for people without diabetes.<sup>12</sup> Indeed a recent study of non-diabetic patients undergoing hepato-biliary surgery again demonstrated the benefits of aggressive control of blood sugar levels leading to reduced incidence of infections and shorter hospital stays, and none of the patients in the study had any episodes of hypoglycaemia.<sup>13</sup> Clearly the need to ensure that blood glucose is kept within an acceptable range is crucial to the success of any intensive insulin regime.<sup>14</sup> Against this background, Ljungqvist *et al.*<sup>5</sup> interpreted their own and other work as showing the need to shorten the catabolic phase related to surgical stress and to achieve this by minimizing insulin resistance in the post-operative period.

### Current approaches

The novel approach adopted has been to challenge the conventional wisdom of fasting prior to surgical procedures. The traditional basis for fasting had been to prevent aspiration, but this view was first challenged in the 1980s and, as a result, many patients were allowed clear fluids up until two hours prior to surgery. The development of low osmolality carbohydrate drinks during the mid 1990s opened up the opportunity of providing surgical patients with a carbohydrate load two to three hours prior to anaesthesia. In a comparative study of 14 patients undergoing colorectal surgery Nygren *et al.* halved post-operative insulin resistance by the use of such oral therapy.<sup>15</sup> In a meta-analysis of three small prospective studies, Ljungqvist's team showed that such an approach can lead to a reduction in hospital stay by about 20%.<sup>16</sup> However, a randomized study in Toronto of 26 patients undergoing coronary artery bypass grafting and 12 patients having spinal surgery who received oral carbohydrate supplements in the evening and two hours before surgery showed no improvement in post-operative insulin sensitivity. The patients who received the carbohydrate supplements did, however, have lower blood glucose and higher insulin levels than the traditionally fasted patients, although these differences were not significant.<sup>17</sup> In contrast, in a randomized study from Brazil of gastrointestinal surgery, the addition of whey protein to the carbohydrate drink appeared to have some added value in terms of reduced inflammatory response and lesser insulin resistance.<sup>18</sup>

The benefits of the ERAS approach to colorectal surgery have been confirmed in several reports.<sup>19,20,21</sup> It can extend for a significant period after surgery.<sup>22</sup> The role of pre-operative carbohydrate supplementation has been assessed in a number of trials. The mechanism by which it acts includes a reduction in catabolism of fat and protein. This was shown in a study of 40 patients who underwent an elective laparoscopic colectomy.<sup>23</sup> However, most studies on the role of pre-operative carbohydrate supplementation have excluded diabetic patients. Clearly the concept of giving a patient with inherent insulin resistance a carbohydrate load prior to surgery is seen by many as "a step too far". Indeed, in 2011 the Joint British Diabetes Societies guideline on the management of adults with diabetes undergoing surgery stated:

*"The Enhanced Recovery Partnership Programme recommends the administration of high carbohydrate drinks prior to surgery. This may compromise blood glucose control and is not recommended for people with insulin treated diabetes."*<sup>24</sup>

However, such a blanket recommendation against the use of high carbohydrate drinks prior to surgery requires re-evaluation. Concerns about potential delays in gastric emptying amongst patients with diabetes and, therefore, the reintroduction of the risk of aspiration, appear unfounded. In a study of 25 patients with type 2 diabetes Gustaffson *et al.* found no delay in gastric emptying compared to healthy volunteers amongst patients given a carbohydrate drink.<sup>25</sup> In 2011, in a study from Poland, Jodlowski *et al.* investigated the benefit of such drinks in 48 patients who were to undergo elective colorectal surgery. Seven had type 2 diabetes. Their conclusion was that a pre-operative oral carbohydrate load was safe and well tolerated by them, although realistically this is much too small a sample from which to make an inference. Overall for both diabetic and non-diabetic patients it improved peri-operative well-being, reduced hunger and reduced insulin blood levels and insulin resistance on day 2 after surgery.<sup>26</sup> This study is of particular importance against the background of a report from Michigan which investigated risk factors for anastomotic leak following a colectomy amongst 5123 patients.<sup>27</sup> The occurrence of a leak was not directly associated with the presence of diabetes but, when it did happen, patients with diabetes had a four-fold mortality of 26.3% compared with 6% for patients without diabetes. Other evidence would suggest that the use of pre-operative carbohydrate loading might reduce this difference in mortality subsequent to an anastomotic leak.<sup>20,21</sup> Unfortunately none of these studies included any reference to whether these patients' diabetes was well controlled or whether they had complications of their diabetes.

The importance of insulin resistance as an independent factor associated with prolonged hospital stay cannot be over emphasized. The potential benefits of carbohydrate loading, for patients with diabetes have been shown in the field of cardiac surgery. A randomized double-blind placebo controlled trial in Germany amongst 160 patients undergoing elective cardiac surgery, including 31 with non-insulin treated type 2 diabetes, reported that blood glucose levels, gastric fluid volume and insulin requirement did not differ between groups. However, patients receiving a carbohydrate load required less intra-operative inotropic support after initiation of cardio-pulmonary bypass weaning ( $p < 0.05$ ).<sup>28</sup> This study provided no details on how well controlled the patients were or the presence of complications, but did specifically exclude patients with type 1 diabetes after initial recruitment.

### Conclusions

Although patients with diabetes have been excluded from most trials looking at the role of carbohydrate loading as part of an ERAS program, there is certainly a need to stimulate a call for a properly conducted large-scale randomized controlled trial of its efficacy in this group of patients. There is some evidence, albeit

from small studies, to suggest that carbohydrate loading preoperatively can be safe in patients with diabetes. Naturally there will be a need to carefully monitor and support such patients - but this is integral to the ERAS approach. Clearly, its potential to shorten hospital stay, give a more rapid return to normal activities and reduce the frequency of serious complications would be of particular benefit.

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## Key messages

### ERAS

- Improves surgical outcome
- Reduces morbidity.
- Hastens return to normal function
- Has a place in the surgical management of type 2 diabetes patients