Improved perioperative glycemic control by continuous insulin infusion under supervision of an endocrinologist does not increase costs in patients with diabetes


Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The authors assessed an insulin infusion glycaemic control protocol (IGCP) that was developed under the supervision and consultation of an endocrinologist. Patients started an intravenous infusion with glucose monitoring every 1 to 2 hours to maintain glucose levels between 120 and 200mg/dL. The endocrinologist determined changes to the insulin regimen when glucose control was not achieved. The protocol was described further in an appendix.

Type of intervention
Secondary prevention of poor surgical outcomes through glycaemic control.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised diabetic patients undergoing coronary artery bypass graft (CABG) surgery. No exclusion criteria were reported.

Setting
The setting was secondary care. The economic study was carried out in Pennsylvania, USA.

Dates to which data relate
The effectiveness and resource use data were collected between January 1999 and December 2000. The costs were reported in year 2000 prices.

Source of effectiveness data
The effectiveness data were derived from a single study.

Link between effectiveness and cost data
The costing appears to have been carried out prospectively on the same sample of patients as that used in the effectiveness study.

Study sample
The authors did not report that power calculations were carried out to estimate the impact of chance on the results. The sample selection appears to have been appropriate for the study question, as it included all diabetic patients in the study setting who underwent CABG surgery during the study period. The patients in the control group were treated between January 1999 and December 1999, while those in the intervention group were treated between January 2000 and
December 2000. There were 81 patients in the conventionally treated group and 107 in the IGCP group. The authors did not report any evidence that the study sample was representative of the study population.

**Study design**
The analysis was based on a prospective comparative study with historical controls that was performed in a single centre (the Pennsylvania State University Milton S Hershey Medical Center). The patients were followed from admission to discharge. There was no reported loss to follow-up.

**Analysis of effectiveness**
The effectiveness study appears to have been conducted on an intention to treat basis. The primary outcomes assessed were:

- the blood glucose measurement for 48 hours following surgery (and the average number of measurements per patient that were performed during this time),
- the total length of stay (LOS; i.e. from admission to discharge) and surgery LOS (i.e. from surgery to discharge), and
depth sternal wound infection (DSWI).

The authors did not report comparison data for the patient groups at baseline.

**Effectiveness results**
The average number of glucose measurements per patient was 7.98 for the conventional group and 23.85 for the IGCP group.

There was a statistically significant difference in glycaemic control. The average blood glucose values were 241.67 (standard deviation, SD=75.93) mg/dL in the control group and 183.46 (SD=53.20) mg/dL in the IGCP group, (p<0.0001).

Hospital LOS was 8.64 days in the control group and 8.25 days in the IGCP group, (not statistically different).

Surgery LOS was 6.58 days in the control group and 6.34 days in the IGCP group, (not statistically different).

The incidence of DSWI was 4.94% in the control group and 4.63% in the IGCP group.

**Clinical conclusions**
The authors concluded that the results demonstrate a "significant improvement in glycemic control associated with the use of a multidisciplinary IGCP in the perioperative period for patients with diabetes undergoing CABG surgery", compared with conventional practice.

**Measure of benefits used in the economic analysis**
The authors did not estimate a summary measure of benefits. Therefore, the study was categorised as a cost-consequences analysis.

**Direct costs**
The authors did not state the perspective from which the costing analysis was carried out. The authors were concerned with the costs incurred from admission to discharge, and thus seem to have been using the perspective of the hospital. The costs were estimated from 1999 to 2000 and were inflated to 2000 prices. Discounting was appropriately not applied, as the costs for each patient were estimated over a very short time horizon (i.e. from admission to discharge). Financial data were reported to have been collected from the hospital's cost accounting database (McKesson).
Corporation, San Francisco). The authors mentioned the additional categories of costs included for the IGCP strategy (i.e. costs associated with more frequent blood glucose monitoring, pharmacy expenditure and routine endocrine consultation), although the categories considered for costing the conventional therapy were not clearly identified. Only LOS was reported separately from the costs; no other resource quantities were reported independently. The estimated costs would appear to be the average costs per patient.

**Statistical analysis of costs**
Univariate comparisons of the costs were made using Student's t-test. The authors mentioned that multivariate comparisons, to determine the incremental effect of increased blood sugar levels on the costs, were performed by linear regression. However, the results of these analyses were not reported.

**Indirect Costs**
The indirect costs were not estimated.

**Currency**
US dollars ($).

**Sensitivity analysis**
The authors did not report that sensitivity analyses were carried out.

**Estimated benefits used in the economic analysis**
See the 'Effectiveness Results' section.

**Cost results**
The total hospital costs were $21,076 in the IGCP group and $21,442 in the control group. The difference was not statistically significant.

**Synthesis of costs and benefits**
Not relevant since a cost-consequences analysis was undertaken.

**Authors' conclusions**
The significant improvement in glycaemic control observed in the insulin infusion glycaemic control protocol (IGCP) group was achieved "without incurring additional treatment-related costs".

**CRD COMMENTARY - Selection of comparators**
The comparator (i.e. conventional practice) was chosen since it was routine practice in the authors' setting before the IGCP was implemented. You should decide whether this practice is widely used in your own setting for the glycaemic control of diabetic patients undergoing CABG surgery.

**Validity of estimate of measure of effectiveness**
The analysis was based on a prospective comparative study with historical controls. This design was appropriate for the clinical question, particularly given the change in protocol at the study setting. The authors acknowledged that the different times at which each group were observed might lead to some systematic unobserved difference between the groups, thus introducing some confounding variables into the analysis. The authors did not report comparison statistics for patients in the two groups at baseline. Consequently, it is not possible to assess whether the results reported in the
paper were associated with significant baseline differences between the study groups. Appropriate statistical analyses were undertaken to compare the results from the two groups and to assess whether statistically significant differences were observed. The authors mentioned some further limitations of the study. For example, the relatively small sample size (they did not report that the sample size was powered to compare the effectiveness outcomes), and the temporal difference between the two patient groups that may have introduced some bias into the effectiveness results.

Validity of estimate of measure of benefit
The authors did not derive a summary measure of benefit. Therefore, the study was categorised as a cost-consequence analysis. The reader is consequently referred to the comments in the 'Validity of estimate of measure of effectiveness' field (above).

Validity of estimate of costs
The authors did not report the perspective from which the costing analysis was carried out. Nevertheless, the costs seem to have been estimated from the perspective of the health care provider or hospital, focusing on the costs incurred between admission and discharge. Some of the relevant costs categories were not clearly identified (those associated with the conventional practice), which makes it impossible to assess whether the relevant elements were measured. Statistical analyses of the costs were performed. The authors gave a valuable discussion of how the increased cost associated with glycaemic control was likely to be outweighed by decreased costs due to fewer infections. The analysis might have been improved by reporting greater cost detail, including a breakdown of the elements and the separate reporting of all unit costs and resource use. The fact that, overall, the resource quantities were not reported separately from the costs would hinder reflation exercises to other settings. The price year was reported.

Other issues
The authors made appropriate comparison of their results with the findings of others that have discovered decreased rates of DSWI and LOS due to tight glycaemic control. The issue of generalisability to other settings was not explicitly addressed, although the authors acknowledged that the patients were treated in a single setting and, therefore, resource use for CABG patients might differ in other settings. The use of diabetic patients further restricted the generalisability of the results to this population of patients. By the authors' admission, the glycaemic limits assessed in this study did not match others found to be beneficial in the literature, causing the authors to suggest that better outcomes can be achieved by even tighter glycaemic control. This raises the possibility that the study could have assessed two different levels of control and assessed the impact of each.

Implications of the study
The authors did not make any recommendations for policy or practice following their analyses. However, they did suggest "extension of this cost analysis to other inpatient circumstances will be of great interest in designing appropriate protocols to improve hospital outcomes in patients with diabetes". In addition, they suggested that the results of adopting tighter glycaemic control protocols for diabetic patients undergoing a CABG should be subject to further assessment.

Source of funding
None stated.

Bibliographic details

PubMedID
15256327