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A study of a pre-operative intervention in patients with diabetes undergoing cardiac surgery

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Summary
Background: Coronary heart disease is common in Type 2 diabetes and often requires cardiac surgery. However poorer outcomes have been reported including increased rates of post-operative infection and prolonged hospital stay.
Aim: The aim of the study was to determine the feasibility and acceptability of a specialist consultation model (pre-operative medical and educational intervention) for type 2 diabetes in the cardiac surgery setting.
Methods: Twenty four patients were assigned usual care or to the intervention group. The intervention group were assessed by a diabetes clinical nurse consultant, dietitian, and endocrinologist during a pre-operative visit. Specific diabetes questionnaires were administered, education was delivered, and protocol-driven changes to the medical regimen were instituted. Length of stay, incidence of post-operative complications, and number of post-operative inpatient review endocrinology visits required were recorded.
Results: Twenty four patients with a pre-operative HbA_{1c} greater than 6.5% (48 mmol/mol) were studied (17 males and 7 females). In the usual care group ($n = 15$), HbA_{1c} pre-operatively was 7.2% (55.2 mmol/mol) compared to 10.1% (86.9 mmol/mol) in the intervention group ($n = 9$). Six weeks post-operatively HbA_{1c} fell significantly in the intervention group by 1.9% (to 8.2% [66.1 mmol/mol]) compared to a reduction of 1.2% (to 7.0% [53 mmol/mol]) in the usual care

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group ($p < 0.05$). No significant differences were observed in length of stay in intensive care or in total hospital stay between the groups: length of ICU stay 54 h for intervention versus 47 h for usual care, total hospital stay (mean 8 days for both); or in rates of post-operative infection. Differences were seen between in the diabetes questionnaires: in the Problem Areas in Diabetes questionnaire and in the Diabetes Treatment Satisfaction Questionnaire ($p = 0.048$).
Conclusion: This small pilot feasibility study suggests there is potential benefit in the acute optimisation of diabetes treatment before elective cardiac surgery.

Introduction

Diabetes is a chronic condition that causes significant health problems including renal, cardiac, neurological and vascular complications (AIHW, 2009). In 2007—2008, an estimated 818,200 Australians (4.0% of the population) had diabetes (AIHW, 2009) and this figure is continuing to rise. Obesity, hypertension, dyslipidaemia, physical inactivity and Metabolic Syndrome each increase the risk for developing diabetes and are also risk factors for developing cardiovascular disease (CVD) (AIHW, 2008; Martinez, 2005). In the longitudinal AusDiab study, over two thirds of all CVD mortalities were in those with diabetes or pre-diabetes (Barr et al., 2006). From population data, 60% of individuals with diabetes develop CVD (Australian Bureau of Statistics, 2009), and often require coronary artery bypass graft surgery (CABG).

As well as being at higher risk of developing CVD, those with diabetes tend to have more complications when CABG is undertaken (Estrada, Young, Nifong, & Chitwood, 2003; Golden, Kao, Peart-Vigilance, & Brancati, 1999; Hakala, Pitkanen, Halonen, Mustonen, Turpeinen, & Hippelainen 2005). Higher rates of post-operative infections were reported in patients with hyperglycaemia compared to patients who were normoglycaemic (Golden et al., 1999; Guvener, Pasaoglu, Demircin, & Oc, 2002; Harrington et al., 2004). Poorer outcomes from cardiac surgery have also been observed with increased hospital cost and increased length of stay for patients with diabetes ($p < 0.001$) (Estrada et al., 2003). Five and 10-year survival rates for patients undergoing CABG have been found to be significantly reduced in patients with diabetes, at 94% and 84%, respectively in individuals with no diabetes, and 89% and 71%, respectively in those with diabetes ($p = 0.001$) (Hakala et al., 2005). Thus, diabetes confers an increased risk of mortality and morbidity in those requiring cardiac surgery. Unfortunately there are no specific guidelines available for those with diabetes undergoing cardiac surgery, although one set of guidelines for elective surgery was identified (National Health Service, 2012). The Society of Thoracic Surgeons has only issued guidelines on blood glucose management during adult cardiac surgery (Lazar et al., 2009). Thus currently there are no available practice guidelines available in managing those with diabetes undergoing cardiac surgery.

One useful clinical measure of diabetes is glycated haemoglobin (HbA_{1c}). Levels of HbA_{1c} greater than 7% (53 mmol/mol) indicate sub-optimally controlled diabetes (Lu, Walker, O'Dea, Sikaris, & Shaw, 2010). The emphasis is now on monitoring patient-specific HbA_{1c} levels rather than achieving a generic HbA_{1c} goal. Accordingly recommendations are that targets for glycaemic control should be assessed individually in each patient and medication adjusted as required (Goodall, Colman, Schneider, McLean, & Barker, 2007). This procedure however, is not always followed optimally. In 2007/2008, a retrospective audit of 28 Australian patients undergoing cardiac surgery with diabetes demonstrated that one third of those with diabetes did not have their HbA_{1c} levels tested pre-cardiac surgery despite attending a pre-admission clinic. The mean (±SD) length of stay was 9.8 ± 4.3 days (range 5—26 days) and the mean HbA_{1c} post-operatively was 7.7 (60.7 mmol/mol) ± 1.3% (median: 7.1% [54.1 mmol/mol]) (Lee & Opie, 2008). Nineteen (64%) of these patients required referral to the Endocrinology Medical Unit for review and received 6.2 ± 4.1 visits and changes to their medication. Of these, 11 patients also referred to the Diabetes Clinical Nurse Consultant (DCNC), six (55%) required more than one visit. Of the nine patients who developed infections or had delayed wound healing post-operatively, seven patients had elevated blood glucose levels (BGLs) (>11.0 mmol/L) at the time infection was identified. The audit suggested that these patients had poorly controlled diabetes prior to their cardiac surgery.

A key question is why do patients have such poorly controlled diabetes? Lack of knowledge about diabetes and its application to daily diabetes self-management has been identified as a significant issue affecting patients' ability to achieve optimal blood glucose levels (Coats & Boore, 1996; Sturt, Hearnshaw, Barlow, Hainsworth, & Whitlock, 2005). Research indicates that many patients do not have sufficient knowledge of their diabetes to manage it effectively after initial education sessions, with many areas of self-perceived knowledge deficits. These areas include diabetes physiology, medications, appropriate diets, practical skills for monitoring blood glucose, and the application of management skills to daily life (Nagelkerk, Reick, & Meengs, 2006; Sturt et al., 2005). The benefits of providing additional education sessions to improve knowledge and self-management ability in a clinic setting, led by specialised diabetes care teams (including nurses, endocrinologists, and dietitians), has been shown to improve not only personal knowledge of diabetes but also BGLs and HbA_{1c} (Chan, Yee, Leung, & Day, 2005; Cooper, Booth, & Gill, 2003; Deakin, Cade, Williams, & Greenwood, 2006; Song & Kim, 2007). Hill-Briggs identified four essential components of problem-solving as applied to diabetes: problem-solving skills, problem-solving orientation, disease-specific knowledge and transfer of past experience (Hill-Briggs, 2003). The paper by Hill-Briggs highlights the importance of including education that promotes self-efficacy and self-mastery and others have used this to build on self-management in diabetes (Fisher et al., 2005).