Use Of An Intravascular Continuous Blood Glucose Sensor During Post Operative ICU Care Of Cardiac Surgery Patients
K. Prasad\(^{a}\), P. Gopal\(^{a}\), B. Crane\(^{a}\), A. Mackenzie\(^{b}\), S. Panda\(^{a}\), P.K. Gade\(^{a}\), N. Barwell\(^{a}\) and Rob Perkins\(^{b}\)

Contact email address: bcrane@glysure.com

Introduction

Close monitoring and control of blood glucose concentrations within defined limits has been advocated for all ICU patients, a practice referred to as Tight Glycaemic Control (TGC). Several clinical studies have demonstrated that there is a close correlation between control of blood glucose concentrations and improved clinical outcomes.\(^{1-14}\) Several attempts to reproduce these initial results saw an increase in hypoglycaemia, demonstrating the challenge of implementing TGC with existing intermittent glucose tests.\(^{15-17}\) Recent research showing an independent and cumulative association between average glucose, hypoglycaemic events, and glucose variability and mortality has increased the need for continuous systems which can provide early warnings of hypoglycaemia and effectively measure variability.\(^{14}\)

GlySure Limited has developed an intravascular glucose monitoring system to simplify the application of hospital protocols for TGC in intensive care. The GlySure Continuous Glucose Monitoring System comprises two main parts, a monitor and a sterile sensor set which includes an integrated fiber-optic sensor/introducer and a fully automated calibration module.

The continuous glucose sensor contains a fluorescent glucose receptor, which produces a signal that is proportional to the glucose concentration in the patient’s blood. The reversible nature of the glucose-receptor interaction promises extended periods of patient blood glucose monitoring, extending into the three days post operative monitoring advocated by Furnary et al.\(^{4-10}\)

The CGM sensor is placed in intensive care patients via a central venous catheter (CVC). As central venous access is required on most of ICU patients, the sensor does not require any additional access lines.

Methods

The study used GlySure sterile, single use sensors and dedicated monitor systems to measure the blood glucose concentration in 24 post cardiac surgery ICU patients continuously and in real time. Before use each sensor was calibrated using the GlySure software controlled calibration system which calibrates the sensor whilst maintaining sensor sterility.

A 5 lumen 9.5 Fr CVC device, allowed the fluorescence optical based sensor to be placed into the patient’s right internal jugular vein through a dedicated proximal lumen of the catheter. The other 4 lumens were used for sampling or infusions.

Blood samples were taken at regular intervals and the glucose concentration was measured on a Yellow Spring Instrument [YSI]. At the time of sampling the monitor was time stamped to allow subsequent statistical analysis between the continuous GlySure sensor and the intermittent YSI values.

Administration of drugs and other therapies were also time stamped on the monitor such that any interference to the sensor performance by the administration of these therapies could be detected. Monitoring ceased when indicated by the patient’s condition or discharge from the ICU.

Patient Profiles

The data presented here are from 24 recent cardiac patients during postoperative ICU care. The patients were all between 27 and 72 years old and underwent either a coronary artery bypass graft (CABG) or mitral valve repair (MVR). The full breakdown of patient profiles is shown in Table 1.

Results

_matched pairs of data from the 24 patients are shown on a Clark Error Grid (Figure 4). 99.5% of the data fell within the A+B region and 92.7% fell within region A. The MARD was calculated to be 7.70%.

The sensors monitored the patient’s blood glucose levels for the entirety of the stay in the ICU. The MARD, from the 24 patients combined, was analysed vs. time (Figure 5 and Table 3).

Conclusions

The results demonstrate good correlation with the accepted standard of blood glucose determination in ICU practice. This can dramatically reduce the need for frequent intermittent sampling and offers the potential for early identification of hypoglycaemic and hyperglycaemic excursions.

References/Acknowledgements

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15. Care Hospitals, Hyderabad, India. GlySure Ltd, Abingdon, UK.