Second National Conference of the Diabetes Inpatient National Network (DINN)

Taking inpatient care forward – a consensus approach

This is a report from the second National Conference of DINN, which was held on 15 December 2008 at the Hotel Ibis, Earls Court, London. The gold sponsor of the event was sanofi-aventis. This meeting report was generated independently by the publisher and conference speakers, with whom editorial control rests.

"We need to work together to achieve consensus as to best practice. We need to work together to achieve good practice – and then get on with it" was Dr Rowan Hillson's (National Clinical Director for Diabetes, London) message in her opening address to the delegates at the Second National Conference of the Diabetes Inpatient National Network (DINN). The conference welcomed over 300 delegates from across the UK, and comprised a series of lectures and presentations on achieving a consensus approach for taking inpatient diabetes care forwards.

Keynote lecture: Hypoglycaemia in hospital

"Little literature exists on this subject," began Professor Brian Frier (Consultant Physician, Edinburgh), making the point that it is important not to assume that all inhospital hypoglycaemia is caused by diabetes.

A blood glucose level of 3.5 mmol/L or less defines hypoglycaemia in people with diabetes. There are many recognised causes of hypoglycaemia, but most are rare. The most common causes are the use of insulin and sulphonylureas in people

with diabetes, and excessive consumption of alcohol in people who do not have diabetes.

Data from the UK Hypoglycaemia Study (UK Hypoglycaemia Study Group, 2007) indicate that severe hypoglycaemic episodes in people with type 1 diabetes become more frequent with longer duration of diabetes (≥5 years) compared with shorter duration (<5 years). In people with type 2 diabetes, severe hypoglycaemia rates are similar between people using either sulphonylureas or insulin for less than 2 years (7%). However, episodes are less frequent in type 2 diabetes than in type 1 diabetes, no matter what the duration.

Looking at hospital admissions for hypoglycaemia does not give a complete story. In Professor Frier's experience, around 10% of people with type 1 diabetes will require assistance from the medical

or ambulance services for hypoglycaemic emergencies, compared with 30% of people with insulin-treated type 2 diabetes. Most episodes in the community are therefore treated by family members or friends. Professor Frier believes that hypoglycaemia could be more successfully treated in the community than it currently is, but, as yet, there have been no studies to show this.

Generally, it is people with diabetes who are admitted for other medical reasons who experience severe hypoglycaemic episodes in hospital, which in some cases can lead to further problems, such as renal failure. This can be due to a number of reasons, such as: over-zealous treatment of diabetic ketoacidosis (DKA) with too much insulin, and not giving intravenous dextrose at an appropriate time during the recovery period, so causing

the blood glucose to fall into the hypoglycaemic range; patients not taking in enough food; and, most alarmingly, incorrect doses of insulin. Professor Frier cautioned the audience against using "U" for insulin dosing on charts, as it can easily be mistaken (or altered) for a zero, increasing the indicated dose by a factor of 10.

Despite the presence in all hospitals of a specialist diabetes team, it is seldom called upon to aid in the inhospital management of people with diabetes. Educating colleagues on the management of insulin in hospital something that the DINN group needs to tackle. "It seems that we're turning a blind eye to hospital management," concluded Professor Frier.

The diabetic foot

"I marvel that society would pay a surgeon a large sum to

remove a patient's leg, but nothing to save it" George Bernard Shaw.

Dr Gerry Rayman (Consultant Physician, Ipswich) began his presentation with the above quote, lamenting practice-based commissioning as it "continues to see that [amputation] is perpetuated."

Amputation is a much-feared consequence of diabetes. It places an immense burden on the amputee, and the mortality rates are not encouraging – around 50% at 2 years post-amputation and rising to 75% at 6 years.

Dr Rayman believes that admission and cost data for the diabetic foot are underestimated due to poor coding for diabetes in general. His own data (Rayman et al, 2004) back this up, with hospital coding missing almost 10% of all amputations, and with over 15% of all amputations being incorrectly coded. These issues with coding have also been noted by Wraight et al (2006) who found that hospital coding "failed to accurately represent the clinical condition in 61% of cases." In addition, Dr Rayman's own data suggest that total inpatient costs for diabetic foot problems are underestimated by 70%.

The diabetic foot is a very costly complication, about £600 million of the £3 billion spent annually on diabetes by the NHS can be attributed to diabetic foot problems.

While it therefore appears that the burden of inpatient care of the diabetic foot is greater than may at first be imagined, the problem can

be addressed. There are now numerous examples of the benefits of coordinated multi-disciplinary care. For example, in Southampton, length of stay was reduced from 50 to 18.5 days, and major amputation rates were reduced by 60%. At King's College London, the integrated care pathway has resulted in a reduction in length of stay by 2 weeks per patient, and major amputation rates have dropped from 13% to 3.5%.

Dr Rayman and his team carried out a review of the primary–secondary care interface in their district, and found there was poor communication between these services, poor understanding among healthcare professionals in the community of their roles in diabetic foot care, and poor communication from inpatient services to the community. It was also discovered that there were important deficiencies in the management of people admitted with diabetic foot complications. There was little awareness of the multidisciplinary foot team, or of the existence of the diabetic foot clinic. On the wards there was generally inadequate footcare, and individuals with diabetic foot problems were often being managed on the wrong wards.

Armed with this knowledge the team set about improving things, primarily through enhancing their profile, improving communication and running education sessions for those in the community and for ward staff, resulting in a 65% reduction in amputations

in 2005–6 compared with 1997–8, a cost saving of approximately £400 000.

"Why does this not occur throughout the country?" asked Dr Rayman. He believes it is because the diabetic foot is not on the agenda for most commissioners.

To address problems with inpatient care of diabetic foot problems, he said, a team has come together to develop a guideline for the management and prevention of diabetic foot disease in community through to secondary care. The aim is to draw up a care pathway for the proper management of active disease of the diabetic foot in secondary care, as well as for the prevention of new foot disease in people admitted to hospital for other reasons. For example, Dr Rayman believes that it is essential that everyone with diabetes should know of their risk of developing a foot problem, the preventative measures necessary, what to do if a problem arises, and what care to expect if admitted to hospital. All those in hospital caring for people with diabetes should be aware of the significant dangers if foot problems are not expertly managed. They should be aware of the very high risk of heel ulceration in diabetes patients admitted to hospital for other reasons. Furthermore they need to be aware that all patients admitted could have a potential or undiagnosed foot lesion and so should have their feet inspected – especially those with a temperature. The multidisciplinary foot team in the hospital should work closely with the community foot protection teams in order

to provide seamless care. Emergency departments must be engaged in ensuring the foot patients follow the correct pathway of care. Dr Rayman concluded that all those involved in inpatient diabetes care should "Think feet!"

Peri-operative care

Mark Strachan (Consultant Physician, Edinburgh) opened his presentation on peri-operative care with a discussion of his own experience as an inpatient in the hospital he works in: "It was an eye-opener," he said. He saw how easy it was to become institutionalised, and was very impressed with the work and attitude of the staff, but especially the nurses. He said that he would recommend it as a way to find out about "the other side" of the service.

It would seem sensible that tight glycaemic control in the peri-operative period is a good idea, but is there any evidence to prove it? Furnary and Wu's (2006) observational study indicated that intensive intravenous insulin for 3 days was associated with a 60% reduction in mortality and a 23% reduction in length of stay.

Lower blood glucose levels have been shown to predict better outcomes for people with diabetes in intensive critical care (Van den Berghe et al, 2001), and tight glycaemic control following coronary artery bypass grafting has been shown to reduce 5-year mortality (Lazar et al, 2004).

However, tight glycaemic control during the surgery itself should be avoided.

For example, Gandhi et al (2007) found that in people randomised to intensive or conventional glycaemic control during surgery there were more strokes and deaths in the intensive group. However, there was no significant difference between groups in terms of the composite endpoint of death, sternal infections, prolonged ventilation, cardiac arrhythmias, stroke, and renal failure within 30 days of surgery.

Louise Hilton (Senior Nurse – Diabetes, Bolton) then presented a review of a 2003 audit on the peri-operative care of people with diabetes in Bolton. The audit found that there was poor adherence to local diabetes guidelines (they were followed in only 35% of cases), and that there were varying levels of nursing, medical and anaesthetic staff knowledge about diabetes; indeed, less than 60% of staff thought that diabetes is a potential problem in peri-operative care. Astonishingly, only 8% of the peri-operative care plans for people with diabetes had any input from the specialist diabetes team.

These results led to the development of a task-force comprising a senior nurse (diabetes), a consultant diabetologist, a consultant anaesthetist, and a modern matron for peri-operative care. This group ran a study day that led to the development of a pathway for pre-assessment. Feedback from the implementation of the pathway indicated that the anaesthetists were receiving fewer referrals and

cancellations than previously, that nurses were more confident, and that length of stay was reduced.

Dr Strachan agreed that there need to be protocols for peri-operative management, but stressed that they need to be simple and easy to follow.

DKA

The EURODIAB study on children with type 1 diabetes (Patterson et al, 2007) indicated that one-third of deaths in the study cohort were attributable to DKA. "We've all seen someone recently who's come through A&E and who they [the A&E department] said had diabetic ketoacidosis, despite having no ketones or acidosis," began Mark Savage (Consultant Physician, Manchester).

Diagnosing DKA, however, should not be difficult: the patient will have diabetes, ketones and acidosis together. Diabetes is indicated by a previous history of the condition, or elevated blood glucose levels. Ketones can be identified using a ketone meter, and acidosis is caused by ketones.

Standard 7 of the National Service Framework for diabetes (Department of Health, 2001) states that, "The NHS will develop, implement and monitor agreed protocols for rapid and effective treatment of diabetic emergencies by appropriately trained health care professionals. Protocols will include the management of acute complications and procedures to minimise the risk of recurrence." The problem with such protocols, Dr Savage believes, is it is

too time consuming for busy healthcare professionals, especially junior doctors, to use them every time they are needed, and, therefore, admissions can be wrongly identified.

Preventing incorrect admissions for DKA can be prevented by good education of all involved, in conjunction with appropriate testing.

Hyperglycaemia and acute coronary syndromes

There are three main questions in relation to hyperglycaemia in acute coronary syndromes (ACS), began Dr Clive Weston (Reader in Clinical Medicine, Swansea):
● Is it important?
● Does it matter?
● What can I do about it?

Studies have shown that the prevalence of hyperglycaemia on admission to hospital due to an acute coronary event is approximately 10% in people without known diabetes (Weston et al, 2007. In those studies including people with known diabetes, up to 25% had admission hyperglycaemia (Oswald and Yudkin, 1987; Kosiborod et al, 2005; Petursson et al, 2007).

Admission blood glucose levels play an important part in determining the likelihood of mortality during an acute coronary event in people without diabetes. Oswald et al (1986) showed that as admission plasma glucose levels increase, so too does the likelihood of mortality.

This trend also persists over time. Studies have shown that a 1 mmol/L increase in admission blood glucose

levels, in people without diabetes, is related to a 2% increase in risk of death by 90 days (Birkhead, personal communication), a 4% increase in mortality risk over 50 months (Stranders et al, 2004), and a 4.3% in increase in "early death" (Scott et al, 2007). These increases are absolute, rather than in terms of relative risk.

Conversely, it seems that this graded risk does not occur in people with diabetes (Kosiborod et al, 2005): only very high or low glucose levels are associated with an increased risk in this population. Goyal et al's 2006 analysis on the CARDINAL (Complement and Reduction of Infarct Size After Angioplasty or Lytics) study data showed that if blood glucose levels are reduced quickly following admission, the risk of death is also reduced, but only in people without diabetes.

These facts suggest that admission hyperglycaemia is an important factor in inpatient care.

Admission hyperglycaemia in people without diabetes in not necessarily a marker of undiagnosed diabetes, nor is it necessarily a predictor of abnormal glucose tolerance. Stress hyperglycaemia is the body's response to catecholamine release due to a stressful event, for example myocardial infarction or stroke, and is relative to the size of the event (Karlsberg et al, 1981). Higher admission blood glucose has also been associated with larger infarctions (Meier et al, 2005), faster heart rate (Foo et al, 2003) and heart failure

(Kadri et al, 2006).

Despite these data, at the present time, there has been no definitive trial showing the benefit of glycaemic control in ACS. Dr Weston described the design that would be needed for such a trial. It should:

- Be a randomised controlled trial (RCT).
- Involve people with and without diabetes.
- Be placebo controlled.
- Show rapid restoration of normoglycaemia after an intervention.
- Induce a substantial difference between intervention and control groups in the first 24 hours following the intervention.

The DIGAMI (Diabetes Mellitus Insulin-Glucose Infusion in Acute Myocardial Infarction) trial (Malmberg, 1999; 2005) is the only major study on ACS that showed significant differences between blood glucose levels in intervention groups, and was responsible, Dr Weston said, for changing practice in coronary care teams. Misinterpretation of the study caused teams to use insulin infusions in people without diabetes less frequently than before. The Myocardial Infarction National Audit Project (MINAP) database shows that approximately 50% of people without diabetes with high admission blood glucose levels were receiving insulin infusions in 2004. Mid-way through 2005 this figure had dropped to 10%.

Dr Weston concluded that hyperglycaemia in ACS is common, could indicate underlying diabetes or excess catecholamine release, is associated with a poorer prognosis than lower blood glucose levels, and has been shown to have detrimental effects on long-term outcomes.

Stress hyperglycaemia

As described above, stress hyperglycaemia occurs as part of the body's metabolic response to a stressful event, alongside a number of other acute phase responses including, for example, increased oxygen demand, hyperlactataemia and protein catabolism. "Over the last 20–30 years hyperglycaemia has come to the fore in critical illness," said Stephen Gough (Professor of Medicine, Birmingham).

Elevated blood glucose may however, have toxic effects on the body, including suppression of immune functions, and increasing inflammatory cytokine concentration. Professor Gough pointed out that in diabetic foot clinics, for example, attempts are made to keep blood glucose levels in single figures to increase white blood cell function and enhance wound healing. In addition, data from an increasing number of studies have shown that in people with higher blood glucose levels after admission to a critical care unit, mortality is increased compared with those in whom blood glucose levels were lower or in whom levels fell within the first 24 to 48 hours (Goyal et al, 2006).

In critically ill children, recent data have shown that the 24-hour change in blood glucose levels following admission appears to be an independent predictor of mortality. An ongoing UK multicentre insulin intervention study based in paediatric intensive care units will hopefully address some of the important issues surrounding stress hyperglycaemia and its subsequent management.

There are several contentious issues surrounding the safety of intensive insulin therapy in patients with hyperglycaemia, particularly with regard to which people are most likely to benefit from intervention and whether or not the benefits outweigh the risks, particularly those associated with hypoglycaemia. There is no consensus as to what level of glucose should trigger insulin intervention and then what concentrations should be aimed for during treatment, in different clinical settings. Increasing evidence suggests that over-treating hyperglycaemia, with resultant hypoglycaemia, may have adverse effects including an increased incidence of cardiovascular events and cardiovascular mortality.

It seems essential that healthcare professionals become more aware of acute admission hyperglycaemia and implement an appropriate screening policy. Not only may an elevated blood glucose level represent an adverse stress response but also undiagnosed type 2 diabetes. As discussed by earlier speakers, a clearer definition of stress hyperglycaemia is certainly required in people admitted with ACS, and perhaps the use of an HbA_{1c} test in addition to the oral glucose tolerance test would better categorise patients.

Professor Gough believes that there is an urgent need for a better definition of admission hyperglycaemia, followed by robust glucose lowering studies with risk–benefit analysis.

Acute stroke

Hyperglycaemia is common in stroke (almost universal in those with diabetes), is associated with poor outcomes and is more likely with pre-existing dysglycaemia, began Dr Keith Muir (Consultant Neurologist, Glasgow). Ischaemic stroke is an evolving syndrome, with damage to the brain proceeding over several hours after the occlusion of an artery. Early intervention to restore blood supply, or possibly control derangements in physiological homeostasis, significantly improves clinical outcomes.

Apart from acute thrombolysis in selected patients, stroke unit care is highly beneficial. This should be on a geographically discrete specialist unit, which has been shown to be significantly more beneficial than either mobile stroke teams or domiciliary care (Kalra et al, 2000). A major survival advantage within the first 10 days on a stroke unit (Stroke Unit Trialists Collaboration, 1997) may arise from more aggressive monitoring and correction of physiological derangements, commonly including hyperglycaemia, in protocols.

In general, the observational data that are available regarding hyperglycaemia and stroke indicates a consistent relationship between raised blood glucose levels and poor

outcome, but information on intervention is limited. Data from several stroke trials in the Virtual International Stroke Trials Archive (VISTA) indicated that persistent hyperglycaemia is a predictor of poor outcomes, and that the majority of people suffering a stroke will become hyperglycaemic at some point (Muir and McCormick, 2007).

European and American guidelines recommend that blood glucose levels be measured and treated accordingly, but Dr Muir suggested that current NICE statements are "a bit schizophrenic" when it comes to stroke, recommending tight control of glucose levels despite a lack of evidence to support this. Several studies are being undertaken, which, hopefully, will provide better quality data on hyperglycaemia and stroke.

The GIST-UK (UK Glucose Insulin in Stroke Trial) study examined death rates in stroke and hyperglycaemia, but found no benefit from glucose–potassium–insulin (GKI) infusion, which lowered blood glucose levels only marginally more than routine saline infusion (Gray et al, 2007). More concerningly, those with larger drops in blood glucose fared worse. The SELESTIAL (Spectroscopic Evaluation of Lesion Evolution in Stroke: Trial of Insulin for Acute Lactic Acidosis) study was a placebo-controlled RCT of insulin on lesion volume progression in acute ischaemic stroke, which hinted that growth of an infarct was worsened

by GKI treatment in some patients who had a persistent large artery occlusion, despite treatment controlling brain lactate levels (McCormick et al, 2007).

Steroids in hospital

The primary issue that arises with steroid use in hospital, for people with diabetes, is that it is associated with hyperglycaemia, said Dr Ketan Dhatariya, (Consultant Physician, Norwich).

Approximately 1% of the general population of the UK is on oral glucocorticoids (mostly for respiratory and musculoskeletal disease). Generally, steroids are used for less than 5 days, and less than 5% of steroids are used for a period longer than 5 years. However, for the inhospital population, there is no reliable estimate for the prevalence of glucocorticoid use, and the doses used in hospital are, generally, greater than those used in community. This may be a problem as the associated hyperglycaemia may adversely affect the 18% of people in hospital with undiagnosed diabetes (Wexler et al, 2008).

It is well known that the adrenal glands produce cortisol that is equivalent to about 7.5 mg of prednisolone daily, and any exogenous doses higher than this will complicate carbohydrate metabolism by increasing hepatic glucose production, inhibiting muscular glucose uptake and affecting beat-cell function (Boyle, 1993; Lambillotte et al, 1997; Hollingdal et al, 2002). If given for longer than 2 weeks, steroids will cause

adrenal suppression, and rapid withdrawal will cause further problems.

Inzucchi (2006) outlined a vicious circle in which the person admitted to hospital with acute illness has increased cortisol levels, is treated with steroids and is doing less exercise, which causes hyperglycaemia. This in turn translates into decreased immune function and wound healing, and potential exacerbation of myocardial ischaemia, which then causes acute illness. This is why inhospital steroid use can be a problem.

Dr Dhatariya reminded delegates that glucocorticoid-induced diabetes can occur, and that the best predictors of this are increasing age, steroid dose and a family history of diabetes.

Steroid-related hyperglycaemia can be treated well with glitazones; however, Dr Dhatariya believes that these may be inappropriate for inpatients, especially women, as they have been shown to have negative long-term effects on rates of cardiovascular death, fracture and macular oedema (Ryan et al, 2006; Nissen and Wolski, 2007). Exenatide may be a possible treatment, but there are no published data on its use in this situation.

The drug of choice in these people, said Dr Dhatariya, is insulin. Prandial insulin ought to minimise the effects of postprandial rises in glucose levels, and for those on high-dose intravenous glucocorticoids, a sliding scale of intravenous insulin may be appropriate (Hirsch and Paauw, 1997).

There is little evidence to

support guidelines on the use of glucocorticoids in diabetes. Setting targets similar to those for outpatients is unrealistic as there are other influences in hospital, such as stress hyperglycaemia and altered nutritional intake. Dr Dhatariya's own recommendations are to aim for a fasting glucose level <7.0 mmol/L, and all other blood glucose readings <10 mmol/L, if they can be achieved without the risk of hypoglycaemia.

Improving the quality of inpatient care

There is only limited evidence regarding inhospital care of people with diabetes, which at best is "good practice", and at worst is negligent said Dr Maggie Hammersley (Consultant Physician, Oxford). Those with diabetes are admitted twice as often and stay twice as long.

Before 2000, most diabetes centres were providing a patchy "outreach" service for people with diabetes, and the first reports were coming through indicating that a dedicated inpatient diabetes service reduced length of stay, said Dr Hammersley.

The Diabetes Inpatient Specialist Nurse forum was founded in 2004, and following surveys of inpatient nurses (which, said Dr Hammersley, suggested that, as usual, doctors were lagging behind nursing staff), and inpatients themselves, DINN was formed in 2007 to span the inpatient–outpatient divide.

DINN was set up with good intentions of raising awareness of inhospital

diabetes nursing, developing and disseminating national guidelines that could be adapted to local practice, and building a research network to improve the evidence base for good practice in this arena.

Other recent initiatives have also placed inhospital diabetes care on the map. During 2008, the National Diabetes Support Team (NDST) produced the document *Improving emergency and inpatient care for people with diabetes*, which focused on three key areas: preventing diabetic emergencies, improving quality and value for money for people with diabetes in hospital, and preventing and treating acute foot complications in hospital (NDST, 2008). The NHS Institute for Innovation and Improvement's project to improve inpatient care for people with diabetes aimed to "improve the care, outcomes and experience of people with diabetes admitted to hospital with non-diabetes related problems".

The Joint British Diabetes Societies Inpatient Care Group, chaired by Dr Hammersley, was formed to provide standards and guidelines for the three nations, and deliver a national agenda for inpatient care.

"Inpatient care is finally coming of age," concluded Dr Hammersley. ■

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