Supporting 'Baby Friendly': a quality improvement initiative for the management of transitional neonatal hypoglycaemia

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ABSTRACT

We describe a quality improvement initiative conducted in a medium-sized district general hospital with a neonatal intensive care unit, which involved working with the multidisciplinary team to create a 'Baby Friendly' neonatal hypoglycaemia pathway with implementation of dextrose gel as a first-line treatment. As a result of the project, formula supplementation rates and admissions for transitional hypoglycaemia were reduced and breastfeeding rates at 3 months improved. This initiative demonstrates that evidence-based guidelines with multidisciplinary team input can improve standards of care.

INTRODUCTION

A junior doctor (CES) new to the postnatal ward recognised that the management of neonatal hypoglycaemia in otherwise well infants was a source of confusion and concern. Often the medical necessity to treat low blood sugar levels (BSLs) conflicted with the desire to promote normality and minimise intervention with formula supplementation in order to promote and support breast feeding as per the Unicef Baby Friendly Hospital Initiative.[1] Furthermore it was noted that the use of portable blood sugar monitors exacerbated the problem, with their inaccuracy at low blood glucose concentrations[2] necessitating multiple blood tests and risking inappropriate treatment. There was clear scope for a quality improvement (QI) project to enhance the medical management of a common problem and improve staff, parent and patient experience.

METHODS

Initial consultation with 20 parents and 61 members of the multidisciplinary team (MDT) elicited their opinions on existing postnatal ward hypoglycaemia management practice, summarised in table 1.

The consultation identified three key challenges:

1. Ensure that hypoglycaemia was being correctly diagnosed
2. Reduce the number of heel pricks per baby
3. Reduce the number of admissions for hypoglycaemia

A three-part audit was performed to review current practice of prevention and management of neonatal hypoglycaemia. This included:

1. A comparison of glucose levels in 50 blood samples measured on the portable glucometers (Ascensia Contour Meter; Bayer) and the blood gas machine (Gem Premier 4000) to check accuracy.
2. A review of rates and indications for formula milk supplementation over a 3-month period (September–November 2013), standardised against Unicef UK Baby Friendly guidelines.
3. A prospective audit of postnatal care for all babies on the hypoglycaemia pathway over a 1 month period (November 2013), including risk factors (birth weight, gestation, maternal diabetes), indication, number of BSL tests per baby, duration of BSL monitoring and formula supplementation rates of breastfed babies. All parents in the cohort were then telephoned 3 months after discharge to determine breastfeeding rates.

A literature review was performed to inform a consensus operational definition of hypoglycaemia. In the 'Sugar Babies Trial', the use of 40% dextrose gel as first-line treatment for hypoglycaemia in term and near-term infants at risk of hypoglycaemia was more effective than feeding alone in correcting low BSL (defined as BSL <2.6 mmol/L).[4] The findings from our audits, the literature and guidelines from 12 other NHS Trusts were reviewed.

Table 1 Summary of opinions from multidisciplinary team (MDT) members

MDT members	Opinion
Nursery nurses	Too many heel prick tests in babies who appeared well
Midwives	Inaccurate glucometers leading to overtreatment; feeling that needing to call junior doctors was over-reaction and led to excessive formula milk top ups
Parents	Inconsistent management, widespread desire to breastfeed but accepting formula on medical advice
Doctors	Concerns about overmedicalisation of otherwise well babies; but insufficient prevention of hypoglycaemia in higher-risk infants
Breastfeeding advisors	High frequency of formula use, inconsistent with progress towards gold standard 'Baby Friendly' accreditation
Managers	Neonatal hypoglycaemia a frequent cause of admission among term infants[3]

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Table 2 Summary of original neonatal hypoglycaemia policy, key findings from root cause analysis and intervention implemented

	Original policy	Key problems identified	QI implemented actions
Operational thresholds	BSL <3.0 mmol/L	Operational threshold too high resulting in overtreatment	Therapeutic objective BSL ≥2.6 mmol/L, operational threshold ≤2.0 mmol/L
First-line treatment	Top up with EBM or formula feed	High rate of formula supplementation	Introduced 40% dextrose gel as first-line treatment
BSL measurement	All BSLs tested using portable meters.	Portable BSL meters read average 0.5 mmol/L lower than blood gas (range 0–2.0 mmol/L lower)	Created microsample glucose-only setting on blood gas machine to validate readings
Monitoring Frequency	All 'at risk'* or symptomatic babies have BSLs tested pre feed and post feed until two consecutive readings were ≥3 mmol/L	High number of heel pricks per baby	New care pathway created with separate 'at risk' and 'clinical concern' plans, both required validating first BSL on the gas machine (baby not started on pathway if symptomatic but not a true low BSL, other causes investigated). Only prefeed BSL tests routinely required and built in escalation
Hypoglycaemia prevention	Not documented	Early feeding and keeping babies warm known preventers of hypoglycaemia	Place to document time to first feed and temperature at each BSL test to encourage early prevention

*Risk factors: any one of (1) infant of a mother with diabetes; (2) <2.5 kg birth weight; (3) >4.5 kg birth weight; (4) preterm (<37 weeks' gestation).
BSL, blood sugar level; QI, quality improvement.

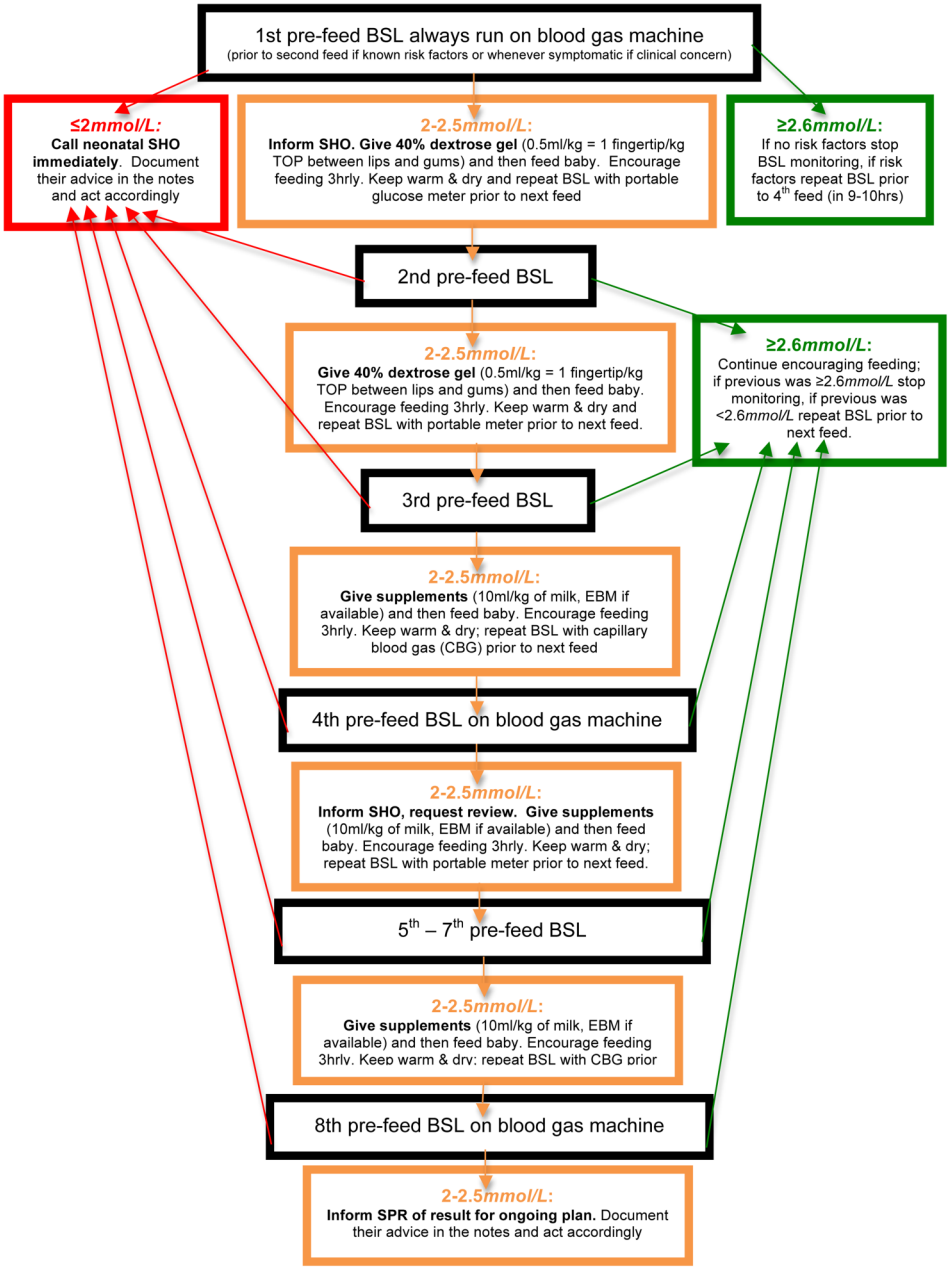

Figure 1 New neonatal hypoglycaemia management pathway for the postnatal ward. BSL, blood sugar level.

A summary of the QI interventions agreed on by the MDT is found in table 2.

We set the operational threshold for medical intervention at ≤2.0 mmol/L and a therapeutic objective of normoglycaemia as BSL ≥2.6 mmol/L. Babies would only be tested if either in the 'at risk' group:

1. Infant of mother with diabetes
2. <2.5 kg birth weight
3. >4.5 kg birth weight
4. Preterm <37 weeks gestation

or if there were clinical concerns about hypoglycaemia.

Prefeed BSLs were to be used for decision-making, and 40% dextrose gel was introduced as the first-line treatment for the first two low BSL readings to allow at least 6 h to establish breast feeding before using formula milk supplementation.

A new care plan agreed on by the MDT limited the number of heel prick blood samples, included space to document risk factors for hypoglycaemia (eg, hypothermia) to raise awareness and encourage correction, and provided clear, timely escalation points if initial treatment failed. The care plan had a management plan flow chart on the reverse (figure 1). We generated a new glucose-only microsample setting on the blood gas machine to periodically validate BSL readings, and trained 58 midwives and nursery nurses in the guideline changes and taking capillary blood samples, with ongoing training for new staff. We anticipated that the majority of babies with BSL between 2.0 mmol/L and 2.6 mmol/L would be managed by midwifery staff without additional medical intervention.

PDSA cycle 1: The intervention was introduced on 1 April 2014. The postnatal care audit was repeated 1 month post implementation for all babies started on the postnatal hypoglycaemia pathway.

PDSA cycle 2: Due to anecdotal reports of fewer term admissions for managing primary hypoglycaemia after the introduction of the new care plan, data on neonatal intensive care unit or special care unit admissions in the 6-month preimplementation period and 6-month postimplementation period were collected from the BadgerNet neonatal electronic database and analysed using interrupted time series analysis.

RESULTS

Postnatal care

The outcomes for 52 babies started on the postnatal hypoglycaemia pathway in the 1-month period before and after the intervention implementation is summarised in table 3. The percentage of babies with risk factors increased post implementation, suggesting more of the babies previously started for clinical concern had a first BLS above the new therapeutic objective and therefore were not started on the pathway. We found that the mean number of heel pricks for BSL monitoring decreased by 73%, and the mean duration on the pathway decreased by 48% after implementation of the new guideline. There was an 88% increase in breastfeeding rates at 3 months post discharge after guideline implementation.

Neonatal service admissions

Table 4 compares the demographic data and quality measures between the babies admitted to neonatal services for primary transitional neonatal hypoglycaemia, (defined as admissions for hypoglycaemia management who were >35 weeks with no comorbidities and no suspected sepsis) over a 6 month period before and after the QI initiative. There was a 73% decrease in the number of babies admitted, with the mean length of stay reducing by a third, resulting in an overall 83% decrease in the total number of admission days (p=0.01). Post implementation no baby had a temperature <36.0° on admission and the range of admission BSLs observed was reduced and on average slightly lower.

Table 3 Summary of results from the postnatal ward care audit pre implementation and post implementation

Quality measures for postnatal care and demographic data	November 2013 (pre)	May 2014 (post)
Total live births	317	362
Babies started on postnatal hypoglycaemia pathway	28	24
Indication=risk factors (%)	20 (71%)	21 (88%)
Indication=symptomatic (%)	8 (29%)	3 (13%)
Mean number of BSL tests per admission	15	4
Mean duration of BSL monitoring in hours from first BSL test <2.6 mmol/L to admission or normoglycaemia (two BSL ≥2.6 mmol/L)	23	12
Babies on hypoglycaemia pathway breast feeding during admission (%)	25 (89)	21 (88)
Breastfed babies on hypoglycaemia pathway who received supplements (%)	24 (96)	11 (52)
Breastfed babies on hypoglycaemia pathway who were still breast feeding at 3 months (%)	8 (29)	15 (63)

BSL, blood sugar level.

DISCUSSION

During the implementation of this QI project we have demonstrated that midwifery-led management using dextrose gel as first-line treatment for neonatal hypoglycaemia is effective and

Table 4 Comparison of quality measures and demographic data for primary transitional neonatal hypoglycaemia neonatal admissions

Quality measures for neonatal service admissions and demographic data	6 months before implementation October 2013–March 2014	6 months after implementation April 2014–September 2014
Total live births	2002	2097
Total NICU/SCU admissions	380	339
Total admissions for primary transitional neonatal hypoglycaemia (% of total NICU/SCU admissions)	41 (10.8)	11 (3.2)
Risk factors for hypoglycaemia (%)	20 (49)	8 (73)
35+0 weeks to 36+6 weeks gestation (%)	9 (22)	3 (27)
≥37 weeks (%)	32 (78)	8 (73)
<2.5 kg	11 (27)	5 (45)
2.5–4.5 kg	28 (68)	6 (55)
>4.5 kg	2 (5)	0 (0)
Infant of mother with diabetes	4 (10)	3 (27)
Temperature <36.0° on admission	4 (10)	0 (0)
Mean BSL on admission (range)	2.3 (1.0–4.8)	1.9 (1.4–2.4)
Treated with intravenous dextrose	10 (24)	4 (36)
Mean length of stay in days per admission	5.8	3.8
Total NICU/HDU days for primary transitional neonatal hypoglycaemia	11	0
Total SCU days for primary transitional neonatal hypoglycaemia	228	42

BSL, blood sugar level; HDU, high dependency unit; NICU, neonatal intensive care unit; SCU, special care unit.

has benefits which extend beyond increasing the BSL. We speculate that the improvement in breastfeeding rates seen may be attributable to less use of the 'fix it with formula' message that we may inadvertently give during the critical establishment of breast feeding.

The numbers included in this study are small. The thresholds for intervention chosen may still be too conservative, but we intended to allow for the inaccuracy of the hand-held monitor and more accurate bedside equipment might allow us to choose a lower operational threshold (eg, 1.8 mmol/L) for some babies, or to continue to use dextrose gel for a third cycle where the blood sugar is still stabilising.

Involvement of the whole MDT at every stage of the QI process was critical. We believe the high levels of engagement and empowerment of the maternity staff have been central to the longer-term sustainability of this work, which has been determined through postimplementation interviews. As the package of interventions were launched simultaneously, it is not possible to attribute the changes in outcomes seen in one particular intervention, nor quantify the impact of MDT working together to implement a universally agreed on consistent care plan.

We would encourage others to implement a similar QI process for transitional neonatal hypoglycaemia, which supports the Unicef Baby Friendly Initiative and may reduce term admission rates and length of stay, as well as other avoidable interventions. A consistent approach to transitional neonatal hypoglycaemia at a national level would represent significant progress.

Correction notice This paper has been amended slightly since it was published Online First. The article type has been changed to 'Quality improvement'.

Contributors CES had the idea for the QI initiative, led the change, helped to write the article and is the guarantor (the contributor who accepts full responsibility for the finished article, had access to any data, and controlled the decision to publish). ELMS had a significant role in the project and has written and reviewed the article. PR is the neonatal consultant supervisor who has offered advice throughout the project and has reviewed and significantly contributed towards the writing of the article. He is the corresponding author.

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Competing interests None declared.

Ethics approval This QI was registered as a service improvement project at St Peter's Hospital and all guideline changes were reviewed by the clinical guideline committee.

Provenance and peer review Not commissioned; internally peer reviewed.

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