FOCUS ON ROYAL UNITED HOSPITAL BATH

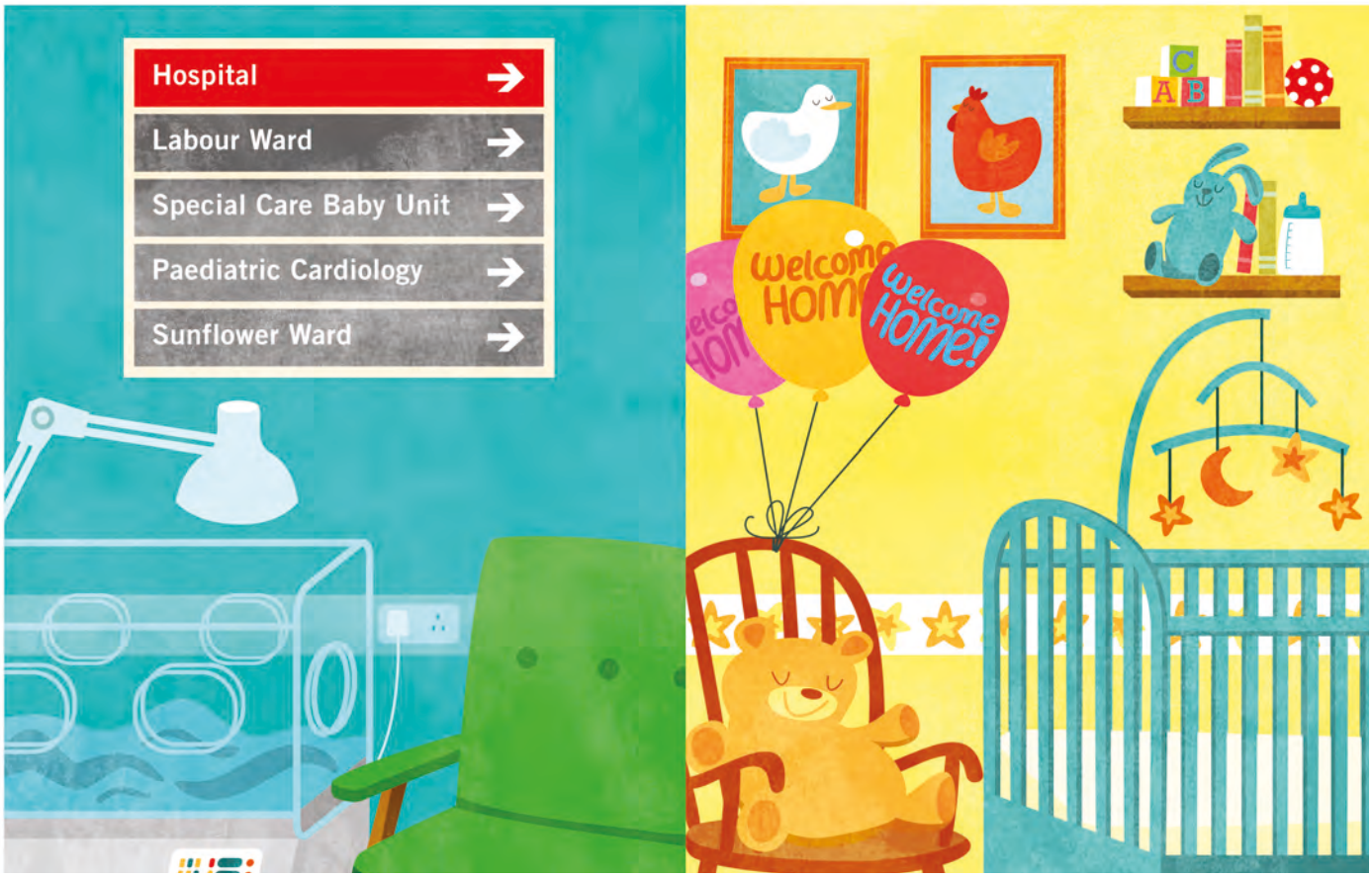
SEPTEMBER 2013 VOLUME 9, ISSUE 5

# infant

for neonatal and paediatric healthcare professionals



PUBLISHED BY
STANSTED NEWS LIMITED

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## EDITORIALS



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## REVIEW AND CASE REPORT



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## CLINICAL PRACTICE



## REPORT



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*Infant* is an independent, peer-reviewed bimonthly journal for the multidisciplinary team that cares for sick or premature babies in their first year of life. The journal contains authoritative articles written by experts in their field, covering a wide range of subjects that reflects the varied roles of the professionals working in this area. Practically and clinically based, *Infant* supports neonatal and infant paediatric nursing and medical practice and develops professional education and health promotion skills. All opinions expressed in the articles published in *Infant* are those of the authors and not necessarily those of the publishers.


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Editorial and business enquiries should be addressed to: Lisa Leonard, Infant Editorial Office, 134 South Street, Bishop's Stortford, Herts CM23 3BQ. Tel: 01279 714508. Email: lisa@infantgrapevine.co.uk

**2013 ANNUAL SUBSCRIPTION RATES**

*Printed journal*

| | |
|---|---|
| UK personal | £49 |
| UK institutional | £180 |
| Overseas personal | £59 |
| Overseas institutional | £190 |

Printed subscriptions now include complete online access to all issues of *Infant*

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Printed by Stones The Printers, Banbury

**ISSN 1745-1205**

Infant is indexed in the British Nursing Index (BNI), the Cumulative Index to Allied Health Literature (CINAHL) and EMCare.




*Infant* believes that whenever possible, breastfeeding is always best for babies, but that mothers are entitled to choice together with information and support regarding alternative methods of feeding.


Volume 9 Issue 5 September 2013





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| **Published by** | Stansted News Ltd, 134 South Street<br>Bishop's Stortford, Herts CM23 3BQ<br>Tel: +44(0)1279 714511 Fax: +44(0)1279 714519<br>Email: info@infantgrapevine.co.uk |

# Facing challenging times in neonatal nursing

**Peter Carter**
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press.office@rcn.org.uk

Children's and neonatal nurses, like everyone in the nursing team, are facing the dual pressures of efficiency savings and structural reform, often alongside organisational cultures prioritising financial targets over patient care.

In his recent report, Sir Bruce Keogh recommended that NHS employers should make efforts to ensure staff are happy and engaged. For too long, nursing staff have been unsupported. Robert Francis recognised some of the most significant pressures preventing nurses from delivering the standard of care they would like.

Now, however, the recent string of high profile reports and inquiries, revealing the pressures facing nurses and evidencing the need for nurses to be given the time and tools to do the job, present new opportunities.

Recently, a study from the Florence Nightingale School of Nursing and Midwifery hit the headlines, revealing the vast numbers of nurses having to 'ration' the care they provide because they simply haven't got the time to deliver it. Eighty-six per cent of nurses had not been able to complete at least one of the 13 care activities they consider necessary for patient care on their last shift. Significantly, the research found this issue to be more prevalent where nurses were caring for high numbers of patients and where they experienced practice environments they perceived to be worse.

One of the major findings of Robert Francis' report was the importance of safe staffing levels in preventing failings in care. This is a critical issue across all specialisms, not least in community services and neonatal nursing, which have older age profiles of nursing staff. Efficient workforce planning is therefore all the more important in this area, as in neonatal nursing which continues to have too few experienced staff. It is vital that employers consider neonatal nursing in their training plans, as the Centre for Workforce Intelligence has recently advised.

Recruiting the right numbers of nurses, with the right skills, is essential if we are to deliver high quality patient care for infants. The RCN continues to call for mandatory staffing levels, enshrined in law, and we have recently published guidance that clearly sets out the minimum nurse staffing levels for providing health services for babies, children and young people.

Where nurses don't have the tools or the skills to do the job, they must be empowered to speak out. For too long, we have seen a closed, pervasive culture in the NHS.

Shockingly, the RCN's recent survey found that a quarter of nurses have been discouraged or warned off raising concerns about patient care, despite the high profile inquiry into Mid Staffordshire. Furthermore, just under half of those who raised concerns said their employer took no action.

Together, we need to ensure nurses are empowered, not punished, when they want to speak up, and that nurses take responsibility to report unsafe staffing levels and speak out when they believe they do not have the right knowledge, skills or competence to do the job.

With children's health, there is a strong recognition of the importance of the partnership between infants, families and those delivering care. Nurses have a major role to play in this.

In developing a model of family-centred care for neonates, the RCN Research Institute found that for parents, their primary needs were communication, support and information. A named key nurse responsible for coordinating care, as recommended by Francis, is a welcome move across settings, and the value of this role in children's nursing is well recognised.

A key nurse ensures parents and carers know who is in charge of and coordinating their child's care, allowing an expectation of regular and predictable contact between patient and nurse.

Looking to the future, nurses need to come together and make the most of the evidence of what already works. In children's nursing we know the importance of taking ownership of patient care, effective communication and safe staffing levels. We know these things work for children and families and we know they work for nurses who feel engaged and empowered to deliver high quality care.

The Francis report presents a watershed moment in the NHS and a real chance to do things differently. The RCN is working hard to ensure the Government, as well as NHS and independent sector organisations, implement the most important of Francis' recommendations to empower neonatal nurses to deliver the standard of care they came into this remarkable profession to provide.

# A well-earned retirement for Claire Greig, Nursing Editor

Claire Greig

Michele Upton

After four years serving as Nursing Editor for *Infant* journal, Claire Greig has decided the time has come to retire from the journal and spend more time with her family. Claire will be sadly missed as she has played a key role in the continuing success of the journal. Her background in neonatal education has enabled her to bring an academic nursing dimension, helping to encourage novice authors and raising the standard of the articles we publish.

Claire has had a long and illustrious career in neonatal nursing. Having trained as a nurse in Edinburgh, she undertook midwifery training in Aberdeen. She then returned to Edinburgh to take the neonatal course at the Simpson Memorial Maternity Pavilion. Although she thoroughly enjoyed her staffing experience in this unit she wanted to broaden her horizons and so emigrated to Canada.

While working at the Foothills Hospital in Calgary she attended the University of Calgary, graduating with a bachelor's degree. She then accepted a Head Nurse post in Halifax, Nova Scotia, in the biggest neonatal unit in Eastern Canada – which must have been a fantastic experience. Returning to Scotland, she worked as a midwife and was then seconded to the University of Edinburgh gaining a Master's degree in Nursing Education and thus began her career in teaching. Since then, she has been based in Edinburgh and has specialised in neonatal nursing education, developing modules and programmes in conjunction with clinical colleagues across Scotland at the same time gaining a PhD and promotion to Senior Lecturer. In October 2007 she officially retired, but has continued to teach on a part-time basis ever since.

Finding a new Nursing Editor to fill Claire's shoes hasn't been easy but I am delighted to report that Michele Upton has agreed to come on board.

Michele started her training as a registered nurse in 1983, going on to train and practise as a midwife for several years in South Africa, before relocating to the UK where she undertook her neonatal training in 2005.

She developed an interest in clinical risk management and patient safety, a role she took great satisfaction in for four years at Addenbrooke's Hospital alongside her clinical role until 2007 when she became the lead nurse for the NICU. In 2010 she was seconded to the East of England Perinatal Network as Innovation Lead, a role she has enjoyed immensely for over three years.

During her time there, she implemented a number of quality improvement initiatives including a care bundle to reduce necrotising enterocolitis rates, a regional simulation training programme, a standardised approach to the safe use of gentamicin and agreeing a regional approach to four key areas of infection prevention and control. Michele was heavily involved in a number of governance-related work streams and has loved working with nursing and medical colleagues, bringing real improvements into the clinical area. In addition she is Newborn Life Support (NLS) trained and supports several centres nationally in delivering NLS.

Michele has a keen interest in large scale change and plans to continue in a strategic role, extending the impact and opportunity an improvement role brings through sharing her experiences from the east of England.

She is currently completing her MSc in Advancing Healthcare Practice through the Open University, focusing on research, innovation and change. Michele is greatly looking forward to learning more, through her Editor's post, about new research and improvements being carried out nationally.

With her wealth of experience in the neonatal field, Michele is ideally suited to taking on the nursing editorship of *Infant* journal and we all look forward to working with her.

Of course the journal doesn't just rely on a Nursing Editor to monitor the articles being sent in and I would like to take this opportunity to thank Anthony Emmerson, the Medical Editor, for all his hard work and support for the journal, which is invaluable and much appreciated. Also thanks must go to the members of the *Infant* editorial board who are instrumental in advising on topics to cover and authors to contact for potential articles. In particular, I would like to welcome new members Nicholas Embleton and Su Monk to the board – we look forward to using their expertise. Finally, credit must be given to our panel of peer reviewers who spend time appraising the articles and giving constructive criticism. All-in-all a team effort – we just couldn't do it without you!

Christine Bishop
Publisher *Infant*

# Flat back of head: positional or pathological?

This article reviews the aetiology and natural history of deformational (posterior positional) plagiocephaly, comparing it with the head shape seen in pathological lambdoid synostosis. The significance and treatment of both conditions are explained, with emphasis on the fact that deformational plagiocephaly is entirely avoidable.

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**Keywords**

Deformational plagiocephaly; lambdoid synostosis; flat head; craniofacial unit

**Key points**

**Burn S.** Flat back of head: positional or pathological? *Infant* 2013; 9(5): 153-55.

1. Deformational plagiocephaly is not usually present at birth; it is acquired but then improves with time.
2. Lambdoid synostosis is present at birth and worsens over time.

Deformational plagiocephaly is an entirely avoidable phenomenon. It is an alteration in head shape due to application of an external deformational force on a flexible object, ie the newborn baby's head. The force is most commonly the cot mattress; babies who sleep well in the first few months of life are more vulnerable than poor sleepers who are likely to be picked up more often. Once the child can sit unaided, pressure is reduced on the back of the head and the condition will gradually improve. While the child is small, there is little hair and the head is largely looked down upon highlighting the flat back of the head. While it is harmless, the appearance tends to cause concern to family and friends. The 'Back to Sleep' campaign initiated in 1992, while having a beneficial effect with regard to sudden infant death, exacerbated the problem. Additional causes include gestational intrauterine constraints, torticollis (wry neck), hemivertebrae and neurodevelopmental delay with poor head control.

Any clinical anxiety is triggered by concern that flattening may be the result of unilateral lambdoid synostosis. While this is rare it has a more worrying natural history. Lambdoid synostosis – fusion of the lambdoid suture located at the back of the skull – can result in a very unusual head shape and the small possibility of increased intracranial pressure and its associated problems, including developmental delay. Lambdoid synostosis comprised only 0.8% of synostotic cases (two out of 237) operated on over a five-year period and makes up an even smaller percentage of the number of new referrals made to the craniofacial unit. The craniofacial unit receives approximately 250 new referrals per year but only about

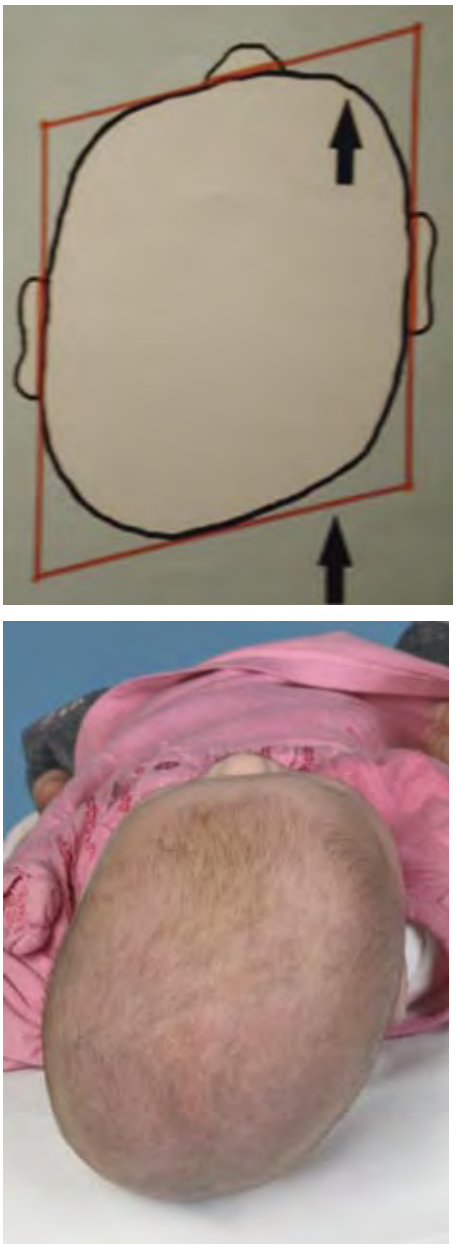

**FIGURE 1** Deformational plagiocephaly, illustrating the typical features including flattening on one side of the head, ipsilateral translocation of the ear and frontal bossing on the affected side.

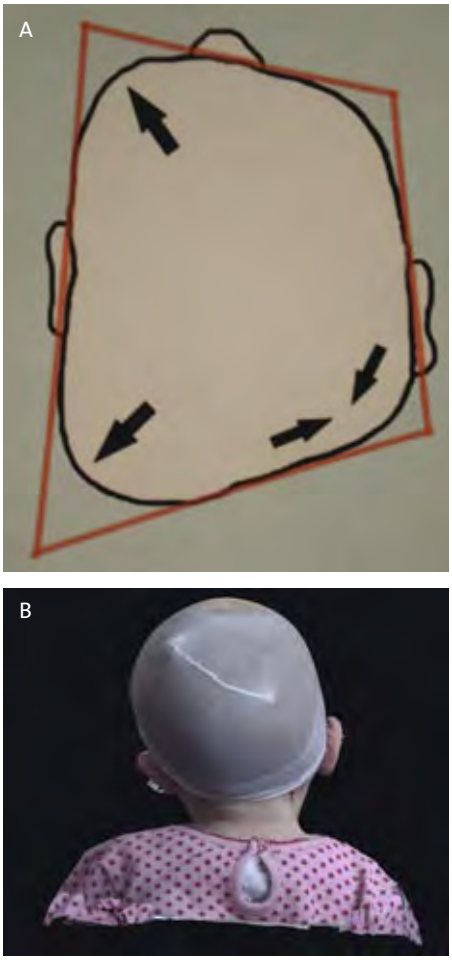


**FIGURE 2** Right lambdoid synostosis. A) An illustration showing flattening on the affected side, posterior translocation of the ear on the right, parietal bossing on the left. B) In a patient, flattening on the right with ipsilateral posterior inferior displacement of the ear.

40% are accepted for surgery. The remainder of the referrals are a mixed collection of concerns but consist predominantly of non-synostotic deformational plagiocephaly patients. Thus there are a comparatively large number of referrals of patients with deformational plagiocephaly compared with patients with lambdoid synostosis.

Deformational plagiocephaly is associated with a number of typical features including flattening on one side of the head, ipsilateral translocation of the ear and frontal bossing on the affected side. This results in a parallelogram shaped skull (**FIGURE 1**).

Lambdoid synostosis may present with variable findings that can mimic the findings in deformational plagiocephaly and thus it can be challenging to diagnose (**FIGURE 2**). Concerns that a flat head may be synostosis rather than positional trigger several referrals to the craniofacial unit.

## Assessment

Clinical history is the most important factor in determining the aetiology of a deformed skull. Questions regarding pregnancy, mode of delivery, head shape at birth, feeding[1,2], sleeping, neurodevelopment and presence of torticollis help to elucidate likely pathology. Charts can be used to attempt to describe the likely diagnosis (**FIGURE 3**).

Examination in the clinic includes overall assessment of:

- head shape
- presence of ridged sutures on the skull
- head circumference
- anthropometric measurements, including anterior posterior skull length, biparietal diameter (skull width), measurement of the oblique angles (right frontal to left posterior parietal and vice versa).

Three-dimensional photographs are taken to further document head shape. X-rays and CT scans are rarely performed as the diagnosis is usually obvious clinically, but if there is any doubt a CT with 3D reconstruction is carried out (**FIGURE 4**).

## Management

Deformational plagiocephaly is managed with reassurance that it will get better over time. Information leaflets are provided. If the baby is less than six months' old, a pressure relieving mattress and 'tummy time' may be helpful. These measures take pressure off the back of the head and therefore allow the flattened side to fill out. Torticollis should be treated with physiotherapy. The unit does not recommend helmets as the condition improves with time and there is little information about the complications of moulding therapy. Surgery is not necessary. If the deformation is severe the child may have follow-up in a nurse-led clinic.

Lambdoid synostosis is managed with posterior cranial vault remodelling at approximately 12-14 months of age, depending on age at presentation. The rationale for surgery is the desire to normalise head shape and the small risk of raised intracranial pressure, which may cause developmental delay, if the condition is left untreated. Patients with lambdoid synostosis are seen in the multidisciplinary craniofacial clinic and are entered onto the comprehensive pre-operative assessment and post-operative follow-up pathway. This includes psychological and speech

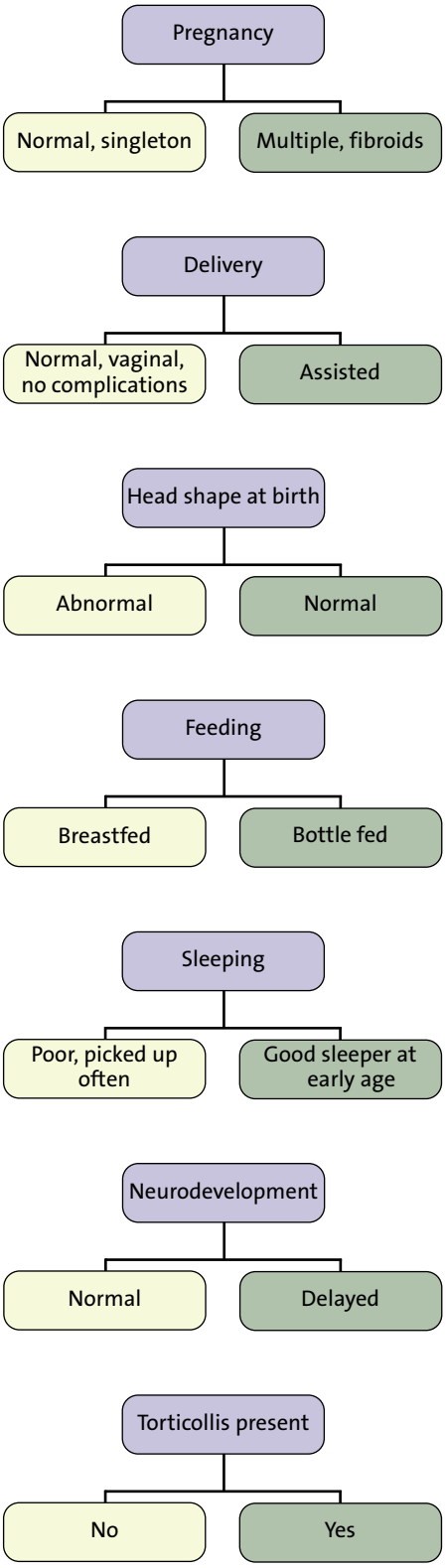


**FIGURE 3** A schematic diagram to aid diagnosis via history. Predominantly yellow answers indicate craniosynostosis; predominantly green answers indicate deformational plagiocephaly. A baby who has minimal risk factors for an external force causing deformational plagiocephaly (green boxes) but has an abnormal head shape is more likely to have craniosynostosis. A normal head subjected to the factors in the green boxes, is more likely to develop deformational plagiocephaly.

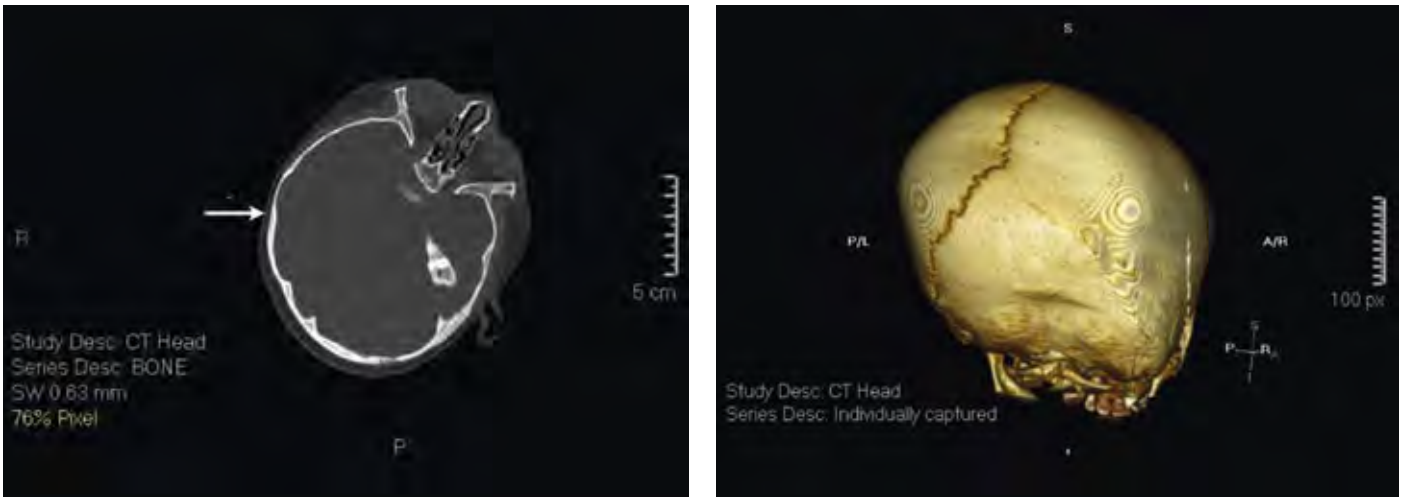


**FIGURE 4** CT scans of the same patient seen in figure 2. Left: an axial bone window CT scan showing an absent right lambdoid suture (arrow). Right: A 3D CT scan showing the absent right lambdoid suture.

and language assessments along with a review by a geneticist.

## Summary

Deformational plagiocephaly is a common condition that improves over time without any intervention but measures to relieve pressure from the back of the head may improve outcome. The key to diagnosis is the history and examination. Lambdoid synostosis is rare but requires surgical treatment. If there is any concern regarding head shape a referral should be made to the regional craniofacial service at:

- Alder Hey Children's Hospital, Liverpool
- Birmingham Children's Hospital
- Oxford Children's Hospital
- Great Ormond Street Hospital, London.

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2. **van Vlimmeren L.A., van der Graaf Y., Boere-Boonekamp M.M. et al.** Risk factors for deformational plagiocephaly at birth and at 7 weeks of age: a prospective cohort study. *Pediatrics* 2007;119:e408-18.

# Building a local neonatal unit fit for the future

FOCUS

BY Debbie Grant, Lead Sister, and Bernie Marden, Consultant

The finished Dyson Centre for Neonatal Care and, inset, building work on the £6.3 million project.

In 2007, it was proposed that the neonatal intensive care unit (NICU) in Bath was long overdue for a face-lift and so plans for the Dyson Centre for Neonatal Care began. The existing facilities were extremely cramped and generally not fit for purpose, making life very difficult for families and staff alike.

The prospect of redevelopment gave us the opportunity to evaluate and take stock of what life would be like in the new world of managed neonatal networks. We would shift from a unit delivering all levels of care to a level two unit, and ultimately a local neonatal unit (LNU). We needed to establish our core values and develop a clear philosophy of care for the future that we could articulate into a coherent and functional design. This was all the more important as it was decided that the build would be funded through charitable donations.

We knew that we would always be busy as we serve an annual birth population of 5,200. We also believed very strongly that whether you are a baby cared for in a level three unit or in a level two unit, you deserve the best quality of care available. The families, in particular, would make no distinction between the different levels of care and they would quite rightly expect state-of-the-art facilities, a knowledgeable and dedicated team of professionals and an environment that was above all caring. As a LNU, it may be that we have unique opportunities to 'add value' in the quality of the care environment, taking advantage of the more balanced mix of intensity.

Our business is to help parents meet their vulnerable offspring in those first precious weeks and build the foundations of a solid family. The care environment would be key in empowering families on the road to taking their babies home. It was very quickly established that we needed to put the family at the centre of the design and to weave in the essential ingredients for establishing a culture where developmental care values are at the core.

Much of this is not too different to the aspirations of many neonatal services, but what we feel makes our unit stand out is our unique approach to establishing the design. The first bold move on the part of the project team was to appoint an architect with no track record of healthcare buildings. Fielden Clegg Bradley Studios is a Bath-based firm with an international reputation for innovation and an impressive portfolio of environmentally friendly buildings. If we were committed to giving our babies the best possible start in life, wasn't it just as important that we gave them a sustainable world with a future to grow up in? Besides, the NHS has encouraged low carbon technology in future capital projects. NICUs are very complex spaces and, if excellent environmental credentials could be achieved within the space, this could be translated into other less complex projects.

The vision was to have a low carbon building with a strong identity with the natural world through the use of imaginative materials – a care environment that had high levels of controllable light and sound. The space is designed so that families can enjoy privacy and also be staffed efficiently, although individual rooms were deliberately shunned to avoid the risk of confusing privacy with isolation at this vulnerable time.

The design is simply stunning. The building is of solid timber construction with the natural timber visible, indeed tangible, in all of the care rooms. The wood is finished with a clear, protective coating that is easy to clean for infection control. There are high ceilings giving an almost cathedral quality to the space, particularly the circulation and mixed function spaces. Glass ceilings give a clear connection with the outside world. Great care has been taken to ensure that every cot

A playroom for siblings.

space is out of direct sunlight. Instead, each nursery room has large bay windows and high-level skylights. Each has integral individually controlled electrical blinds. This is complemented by a sophisticated and programmable lighting system. Bay windows double up as comfortable window seats, allowing parents to step away from the cot space for contemplation without being too far from their babies.

Each cot space is orientated into a corner. This gives a sense of intimacy and comfort not found in the traditional linear layout of a nursery. This is further enhanced by each cot space having airline business class style seating for parents to use while delivering skin-to-skin care or enjoying quiet time.

Having set out such an ambitious vision, it wasn't surprising that it would carry a very hefty price tag of £6.3 million! All we had to do was raise the money and sell the project. Thankfully the Royal United Hospital (RUH) Bath has a fantastic in-house team of fundraisers called Forever Friends. This would be their biggest challenge and would certainly be a learning curve for all concerned.

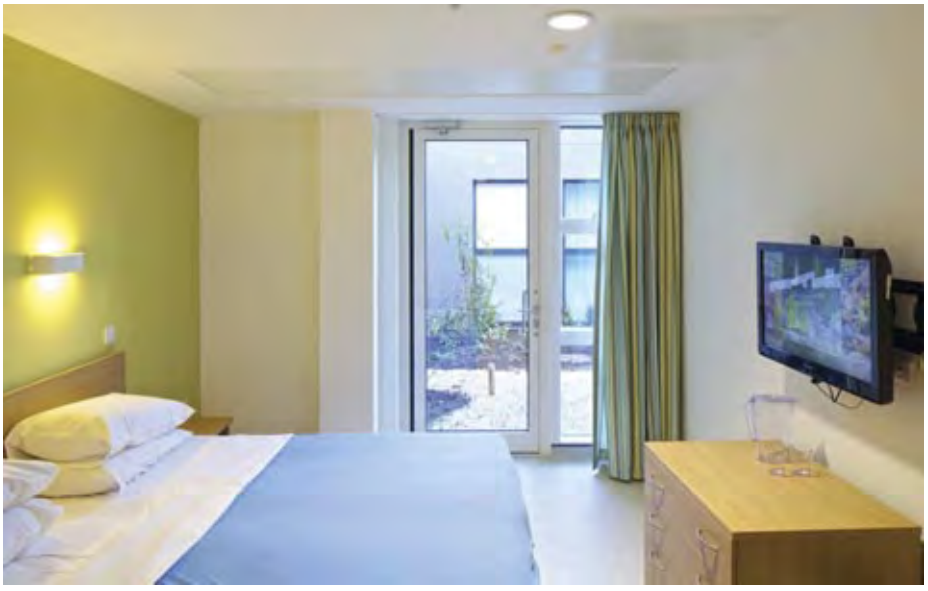
A major breakthrough came when the Strategic Health Authority agreed to fund approximately 50% of the project. With this vote of confidence, other donors came on board and interest grew. The most significant contribution has come from the Dyson Foundation, with personal interest from Sir James and Lady Dyson. The support from the entire community has been overwhelming and has led us to develop many relationships that we hope will continue long into the future. To see old patients and their families pitching in to help others, and school children give their pocket money is a very humbling experience. Of real interest is just how much understanding there is of the needs of vulnerable babies and their families; everyone seems to know someone who has needed a service like ours.


High ceilings lend a cathedral-like quality to circulation areas.

Below: Large bay windows and skylights flood the NICU with natural light.

After several years of meetings, charity events, talking to community groups and schools, we finally took possession of the building in July 2011. The old unit is adjacent and has now been converted into en-suite parent facilities and a high quality shared office space with seminar room and breakout spaces for privacy.

The benefit of our new space seems to speak for itself. We have adapted well and the families tell us they really like it. Rather than take this for granted, we are assessing the impact of the building through a research project. We have created a data set that includes babies, family, environmental and staff data. We have interviewed families about their experiences and we have used specialised equipment to monitor staff journeys. We began collecting the data in the old unit and are now completing collection in the new building. This work has been supported by the Dyson Foundation and has allowed us to put together a unique team of professionals including a neonatologist, NICU nurse, medical physicist and engineers, a clinical psychologist and a dedicated research nurse. We look forward to having data to analyse very soon and then we can really begin to share our experience of building a care environment – starting from the baby and family and building up.



The old NICU has been converted into accommodation for parents.

# VACTERL-H syndrome

VACTERL is an acronym for a combination of congenital malformations of the **v**ertebrae, **a**nus, **c**ardiac tissue, **t**rachea, o**e**sophagus, **r**enal tissue and **l**imbs. This report describes the case of a preterm infant who was diagnosed with VACTERL associated with hydrocephalus (VACTERL-H). The features of VACTERL/VACTERL-H and the basic principles of diagnosis and management at birth are reviewed.

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## Keywords

VACTERL-H; VACTERL; hydrocephalus; Fanconi anaemia

## Key points

**Konstantinidis A., Emmerson A.** VACTERL-H syndrome. *Infant* 2013; 9(5): 158-61.

1. VACTERL-H is a rare expanded form of VACTERL that is associated with hydrocephalus.
2. Both autosomal recessive and X-linked inheritance have been described for VACTERL-H.
3. Fanconi anaemia is a major association of VACTERL-H.
4. VACTERL-H is associated with worse mortality and neurodisability than classical VACTERL.
5. Clinical management of affected infants at birth includes surgical correction of the defects as well as nutritional support measures pre- and post-operatively.

VACTERL-H is an expanded form of the VACTERL association. First described in the 1980s[1,2], it is characterised by congenital malformations of the vertebrae, anus, heart, trachea, oesophagus, renal system, limbs (VACTERL) and associated hydrocephalus (VACTERL-H). **TABLE 1** summarises the most common anomalies that are present in VACTERL association per body system. A diagnosis is based upon the presence of at least three component features plus hydrocephalus, provided there is no clinical or laboratory evidence of an alternative diagnosis[3]. There are case reports suggesting that central hypothyroidism is an additional component feature in the phenotypic spectrum of VACTERL-H[4,5]. A single umbilical artery may be an additional feature although the exact frequency of this feature cannot be estimated[3].

## Case report

A male infant was born via an emergency caesarean section following induction of labour at 34 weeks' gestation for increased fetal head size and failure to progress. There was an antenatal diagnosis of polyhydramnios with tracheo-oesophageal fistula, progressively worsening bilateral brain ventriculomegaly and mild right renal hydronephrosis. The parents were not consanguinous and there was no history of abnormalities in their previous offspring.

At birth, the infant did not need resuscitation (Apgar scores of 9 at one and five minutes). Following transfer to the neonatal unit, he was breathing air and was started on intravenous 10% dextrose at a rate of 60mL/kg/day. Examination revealed a head circumference of 35.3cm (>99.6th centile) with an extra double thumb on the

| | Features |
|---|---|
| Vertebrae | Hemivertebrae, butterfly vertebrae, wedge vertebrae, rib anomalies supernumerary vertebrae, vertebral fusions |
| Anus | Imperforate anus/anal atresia |
| Cardiac | Structural cardiac abnormalities (eg ASD, VSD, AVSD, PFO) |
| Trachea | Tracheo-oesophageal fistula |
| Oesophagus | Oesophageal atresia |
| Renal | Unilateral/bilateral renal agenesis, horseshoe kidney, dysplastic kidneys, ureteral anomalies |
| Limbs | Radial anomalies, thumb aplasia/hypoplasia, polydactyly, lower limb deformities |
| **VACTERL-H** | **Any three of the above plus hydrocephalus** |

**TABLE 1** Features of VACTERL and VACTERL-H.
Key: ASD = atrial septal defect, VSD = ventricular septal defect, AVSD = atrioventricular septal defect, PFO = patent foramen ovale.

**FIGURE 1** Left forearm malformation with radial aplasia.

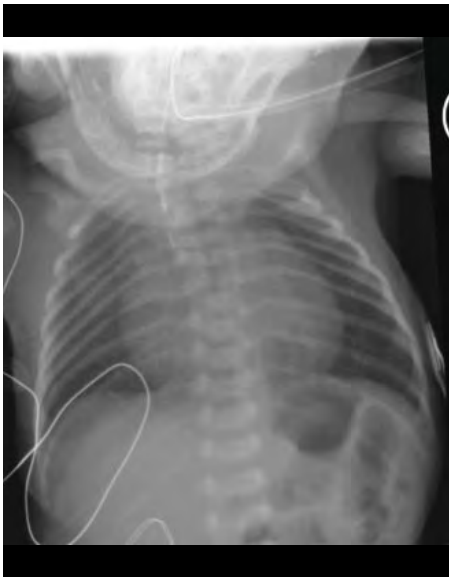

**FIGURE 2** An anteroposterior (AP) chest X-ray following Replogle tube passage. The tip of the tube lies at the level of T5. A diagnosis of oesophageal atresia was confirmed.

right hand and radial aplasia on the left forearm (**FIGURE 1**).

A Replogle tube was sited in the oesophagus and a chest X-ray showed the Replogle tube tip lying at the level of T5 (**FIGURE 2**). The baby appeared to have 13 pairs of ribs and hemivertebrae were present at the level L4-L5. Based on these findings, a diagnosis of VACTERL association was made. Antenatal chromosome studies on samples from amniocytes revealed a normal 46XY male pattern and ruled out Fanconi anaemia. A cranial ultrasound on day three revealed an absent septum pellucidum and bilaterally enlarged ventricles. This was confirmed by magnetic resonance imaging (MRI) (**FIGURE 3**), which also revealed the absence of the corpus callosum. The cerebral aqueduct could not be visualised. A repeat renal ultrasound scan showed resolution of

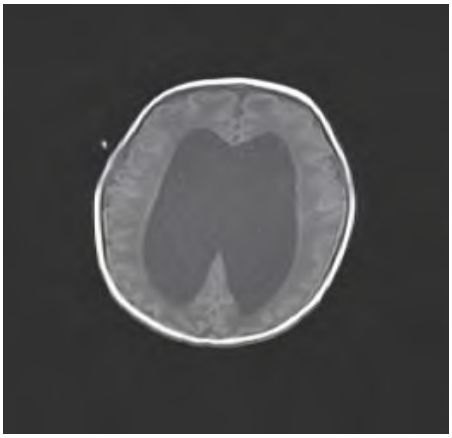

**FIGURE 3** A brain MRI showing bilaterally enlarged ventricles with an absent septum pellucidum.

the antenatal hydronephrosis. A cardiac echocardiogram revealed a small patent foramen ovale (PFO)/patent ductus arteriosus (PDA) and possible muscular ventricular septal defects (VSDs).

The baby underwent surgical repair of the tracheo-oesohageal fistula and oesophageal atresia on day two. The fistula at the level of the carina was divided and closed, the ends of the two oesophageal pouches were brought together with moderate tension, a primary anastomosis was made and a transanastomotic tube (TAT) was placed. In the post-operative period, the infant failed extubation twice, due to increased oral secretions with airway compromise. A pre-extubation course of oral dexamethasone was given and the baby was extubated successfully onto bilevel positive airway pressure (BiPAP) on day 23 and was subsequently changed onto continuous positive airway pressure (CPAP) by day 28. Initially the baby received feeds with term formula milk via the TAT tube. The TAT tube was removed along with the endotracheal tube on day 23 and bottle feeds with specialised preterm formula milk were introduced. Episodes of aspiration were reported, which improved with a change of the formula milk and the introduction of ranitidine and domperidone. A barium swallow test revealed severe oesophageal dysmotility with reflux and a small stricture at the area of the previous anastomosis. Due to increasing head circumference, a ventriculoperitoneal shunt was inserted on day 41 of life.

On discharge, the infant was fully fed on thickened formula milk by bottle with additional feeds via a nasogastric tube. He required low flow oxygen via a nasal cannula. At the age of four months, there were no major visual concerns and his optic discs did not appear hypoplastic on fundoscopy. An orthopaedic referral was made to plan reconstructive surgery for the left radial aplasia.

## Discussion

### Aetiology

For the VACTERL association the estimated frequency is one in every 10,000 to 40,000 infants[3]. VACTERL-H is less frequently seen yet recognised as a distinct clinical entity; it has been reported in more than 50 patients[4]. The VACTERL-related anomalies are a result of a defect in mesodermal differentiation during early embryogenesis[6,7]. It is suggested that the pathogenesis of the syndrome can be explained on the basis of the 'developmental field complex' (DFC)[7] – the part of the embryo that responds as a coordinated unit to embryonic induction resulting in complex or multiple anatomic structures[8]. A disruption in the function of the DFC may result in multiple and sometimes distally located anomalies, such as the ones seen in the VACTERL association[6]. The presence of hydrocephalus in VACTERL-H is secondary to aqueductal stenosis, Arnold-Chiari malformation or non-progressive ventriculomegaly[9].

### Genetic factors

There is evidence that genetic factors are associated with the development of the anomalies[3] however, the contribution of genetic factors in the development of VACTERL and VACTERL-H is different. Mutations in genes that have key roles in various signalling pathways have been implicated for VACTERL. The sonic hedgehog (*SHH*) signalling pathway plays a role in many processes during embryonic development[10]. Animals with mutations in genes associated with the hedgehog signalling pathway demonstrate features of VACTERL[3,10]. In humans, mutations or deletions in genes directly associated with hedgehog signalling (eg *FOXF1, HOXD13*) have been reported in patients with VACTERL-like phenotypes[10-12]. There have been some case reports of patients with VACTERL with concomitant mitochondrial dysfunction signs later in life, suggesting a potential genetic linkage[13,14]. Both X-linked and autosomal recessive forms have been described for VACTERL-H, which are clinically

indistinguishable[3,15]. There have been reports of sporadic patients with a VACTERL-H phenotype on whom a high rate of chromosomal breakage was observed[16,17]. Mutations in the Fanconi anaemia complementation group B gene (*FANCB*) have been associated with VACTERL-H[18]. Mutations in the *ZIC3* gene, which encodes a transcription factor that plays a key role in the left axis body formation, have been associated with a VACTERL-H phenotype. Ninety per cent of cases of VACTERL are sporadic with increased risk when there are multiple affected family members[3].

### Associations

Fanconi anaemia is considered one of the major associations of the VACTERL-H syndrome. There is known phenotypic overlap with shared features such as radial abnormalities, hydrocephalus and other manifestations included in the VACTERL spectrum. Furthermore, as mentioned above, mutations in *FANCB*, which are known to cause Fanconi anaemia, have been associated with VACTERL-H[18]. A definitive diagnosis of Fanconi anaemia can be established by chromosome breakage studies on DNA obtained from blood or antenatally, from amniocytes.

Rhombencephalosynapsis is an uncommon cerebellar malformation characterised by fusion of the cerebellar hemispheres and the dentate nuclei. Abnormal formation of the fetal roof plate and the primitive cerebellar primordium result in various brain abnormalities such as holoprosencephaly, absent corpus collosum, neural tube defects and aqueduct anomalies. A morphological study of 40 fetuses with rhombencephalosynapsis, following medical termination of the pregnancy, revealed six cases of fetuses with VACTERL-H, suggesting a potential association between these two entities[19].

Caudal regression syndrome is a congenital malformation characterised by abnormal formation of the lower spine and sacral agenesis. The anorectal malformations seen in VACTERL have been suggested to be an overlapping feature with simultaneous occurrence of defects in distal anatomic sites[20].

### Antenatal diagnosis

Antenatal diagnosis of malformations included in the VACTERL/VACTER-H syndrome is possible with the use of conventional ultrasonography or more sophisticated imaging techniques such as prenatal echocardiogram and MRI. Polyhydramnios and absent gastric bubble on the 20 week anomaly scan are highly suggestive of tracheo-oesophageal atresia/fistula. Distal colon dilatation is a sign associated with imperforate anus. Enlarged brain ventricles, bone and spine deformities can be ascertained with ultrasonography. The presence of a single umbilical artery should raise suspicion of VACTERL and lead to a careful antenatal examination for recognition of VACTERL anomalies. The diagnostic accuracy of antenatal ultrasonography depends on the experience and the skills of the ultrasonographer.

### Management

The management of affected infants starts at birth with the surgical treatment of malformations that are incompatible with life. A colostomy is performed to treat an imperforate anus, followed by re-anastomosis and 'pull through' surgery. A tracheo-oesophageal atresia/fistula is treated with ligation of the fistula and anastomosis of the oesophageal pouches. Ventricular taps and ventriculoperitoneal (VP) shunting are used to release the increased intracranial pressure seen in hydrocephalus. Other anomalies seen in VACTERL/VACTERL-H can be treated surgically, depending on the nature of each malformation. Total parenteral nutrition (TPN) in the post-operative period is of major importance to ascertain nutritional support and stable growth until enteral feeds are fully established. Since most of the malformations carry a risk of long-term complications, a multidisciplinary team approach is followed to deal with post-discharge complications in the community.

### Prognosis

During a 10-year follow-up period of infants with VACTERL, the estimated mortality rate was 24%, mainly due to cardiovascular abnormalities[22]. Prematurity and low birth weight are post-operative mortality risk factors[22]. Significant morbidity following repair of tracheo-oesophageal abnormalities has been reported due to increased incidence of complications such as oesophageal stricture and anastomotic leaks[21]. Anorectal and vertebral anomalies are associated with variable but poor functional outcomes in later life[21]. These outcomes have improved with the development of advanced surgical techniques and tertiary specialist centres[24]. Patients with VACTERL do not typically display neurocognitive impairment[3]. The prognosis for VACTERL-H is generally worse. There are only a few cases of infants surviving beyond infancy[23] and further studies are needed to evaluate their long-term outcomes.

## Conclusion

Despite phenotypic similarities, there is evidence that the rare VACTERL-H syndrome is genetically distinct to the classical VACTERL association. With modern imaging antenatal diagnosis of the syndrome is possible. Fanconi anaemia is a major association of the syndrome and, when features suggestive of the syndrome are present on antenatal scans or at birth, chromosomal breakage studies should be considered to exclude the disorder. Along with surgical and nutritional management of affected infants, early geneticist involvement and genetic counselling is an essential part of the VACTERL/VACTERL-H care pathway.

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## Book review

### Maternal and Infant Nutrition and Nurture: Controversies and Challenges, Second edition

**Edited by Victoria Hall Moran**

**Quay Books, 2013**
**ISBN: 978-1-85642-435-6**
**£29.99, paperback**

Improved nutrition is increasingly seen as an achievable way of enhancing health outcomes for mothers and infants, both in the short and long-term. There are already many good books that examine this issue; finding space in a crowded market for another is not easy. Most of us work in an increasingly specialised area (eg preterm infants) and have a tendency to go for books relevant to our niche interests. It is always useful though, to see things from a different perspective.

*Maternal and Infant Nutrition and Nurture* is a book to read and browse, rather than a definitive source of text for, say, nutrient requirements. There are 10 chapters covering quite a diverse mix of subjects: from biology (antioxidant micronutrients in pregnancy) to practice (feeding preterm infants), and policy (breast milk substitutes) to psycho-sociology (nutrition in breastfeeding adolescents). When I first looked at the chapter titles I was a little confused – exactly who is this book aimed at? If I'm honest, I probably wouldn't have bought this book, but as I carried it around – it's small and easily fits into a day bag – I found myself dipping into a chapter here and there. I certainly came across perspectives or insights I wouldn't ordinarily gain.

Overall, it is well-written and well-referenced but more importantly, it has a readable style. I particularly liked the chapters on reasons why breastfeeding mothers weigh their babies and professional views on peer support for breastfeeding. One of the greatest shortfalls in current medical or nursing training is a lack of understanding of qualitative research methods, or a failure to see issues from anything other than a pure biomedical perspective. A wise professor once taught me that practitioners should be interested in social behaviours as well as cellular behaviours if we are to improve child health. This book gives a nice mix of both.

**Nicholas D Embleton**
**Consultant Neonatal Paediatrician**
**Royal Victoria Infirmary**
**Newcastle upon Tyne**

# Cutting the cord: an international conference

Dr Tonse Raju's presentation.

*Images provided by Chris Masterton.*

Sixty delegates from the USA, Australia, Sweden, France, Ireland and the UK gathered at the University of Birmingham on 19 April 2013 to attend the first conference to address the topic of transitional care at birth, organised by Dr David Hutchon. The conference explored in detail our current understanding of physiological transition at birth. Textbook teaching of transition at birth is strongly influenced by the intervention of a cord clamp and Dr Hutchon illustrated how this affected our understanding of many so-called 'normal' ranges.

Dr Tonse Raju, from the Eunice Kennedy Shriver National Institute of Child Health and Human Development (USA) presented the latest results of animal studies published from Melbourne, Australia. He explained how early or immediate cord clamping (ICC – less than 10 seconds after birth), before established respiration, causes a 50% fall in right ventricular output together with marked bradycardia, which only recovers slowly after ventilation onset. Delaying cord clamping (DCC – greater than 30 seconds of birth) until ventilation is established assures a smoother adaption of transitional circulation. Professor Susan Niermeyer from Colorado presented the latest International Liaison Committee on Resuscitation (ILCOR) neonatal resuscitation recommendations. She proposed that ICC might lead to the baby needing resuscitation. She explained that there is a critical level of blood pressure for perfusion to fill the pulmonary vascular tree during transition.

Many believe that ICC is required for effective measurement of cord blood gases but Dr Nana Wiberg presented her experience in sampling cord blood gases directly from the intact umbilical cord, allowing cord clamping to be delayed. Dr Ola Andersson presented the results of the Swedish randomised controlled trial comparing ICC and waiting for 180 seconds. This study confirmed that DCC is just as important in high resource countries as it is in low resource settings, as seen in previous studies.

Professor Judith Mercer presented the latest Cochrane review of DCC in preterm babies. There was no evidence that DCC was a risk for hypothermia. There was no significant increase in babies requiring treatment for hyperbilirubinaemia. She pointed out that bilirubin is known to have significant antioxidant properties and that a slightly higher level of bilirubin may in fact be an advantage. Babies with DCC had fewer intraventricular haemorrhages (IVH) of all grades. She also reported increased superior vena cava blood flow after DCC, indicating an increased cerebral blood flow over the first five days of life. She presented a hypothesis about the cause of death in a small number of neonates where there had been documented evidence of a fetal heart rate before birth, but asystole at birth and failed resuscitation. She proposed that as the body of the infant is squeezed tightly in the birth canal, blood is sequestered into the placenta. Before delivery the birth canal pressure acts like an anti-shock garment maintaining the circulation, but at birth the pressure is suddenly released, which may cause hypovolaemic shock and asystole.

From left, Professor Susan Niermeyer, Dr Nana Wiberg and Professor Judith Mercer.

Dr Carl Backes presented the data of a small randomised controlled trial of ICC vs DCC carried out at the Nationwide Children's Hospital, Ohio. Notably DCC was also associated with a significantly higher mean blood pressure over the first 24 hours of life, and a four-fold reduction in use of blood pressure support. IVH or death was also reduced after DCC.

Dr John Monaghan presented data from the National Maternity Hospital in Dublin, which has a record of every case of neonatal encephalopathy over the past 30 years. He looked at the relationship between neonatal encephalopathy, which is a precursor to cerebral palsy in 25% of cases, and intrapartum events and care. Using the American Congress of Obstetricians and Gynecologists (ACOG) criteria for cerebral palsy to be attributed to intrapartum events, he showed that there was in fact a very poor correlation between neonatal encephalopathy and intrapartum events. In more than 70% of babies the cord pH was above 7.0. Of babies that had a pH over 7.2, a large number were delivered by emergency caesarean section or assisted vaginal delivery. These are the most likely to have had ICC, which may be the underlying insult. He finished by showing preliminary data for the normal heart rate and oxygen saturation at birth in babies with DCC, which when compared with the 'Dawson charts' (reference ranges for pulse oxygen saturation values in the first 10 minutes after birth for preterm and term infants), showed no bradycardia or hypoxia.

Mrs Margaret Thomas from Liverpool Women's Hospital presented initial evaluation of the LifeStart trolley, which has been designed to facilitate DCC. A total of 48 babies had been managed on the trolley, including seven babies less than 33 weeks' gestation and three babies less than 1kg in weight. Temperature maintenance and airway management were both good, with mask ventilation in 16 babies and intubation in six babies achieved. She also reported positive parental and midwifery feedback with improved communication between the clinicians and the parents. In very preterm babies the short cord makes getting the trolley close to the perineum essential.

The meeting ended with dinner at a local restaurant. All participants felt the conference was a big success and are looking forward to a follow-up event in 2014.

**By David Hutchon**
Retired Consultant Obstetrician, Darlington Memorial Hospital

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NCT is seeking to understand the issues parents face in the early years.

## The first 1,000 days

NCT (the National Childbirth Trust) is conducting a UK-wide, two-year, longitudinal study that focuses on the experiences of parents within the first 1,000 days of their babies' development.

The charity is inviting first-time parents to take part in the study when their babies are around six to nine months old. Parents will be asked about different aspects of their family life, such as their infants' sleep, play and feeding and balancing their work and home lives. The same parents will be followed up when their children are around 18-21 months old.

The first 1,000 days, a critical time in a baby's development, can bring challenges and worries for new parents. NCT is keen to understand these issues and hopes the project will provide information to guide future strategy, develop new services, increase geographic and social reach and help inform debate and policy on maternity and family services in the UK.

**For further information about the study, visit www.nct.org.uk/press-release/nct-and-pampers-launch-two-year-study-parents-first-1000-days**

## Raising the bar: care for mothers and babies

The National Institute for Health and Care Excellence (NICE) has issued a quality standard on postnatal care to improve the care and support for women and their babies in the postnatal period. For most families this time is uncomplicated, but for those who develop complications care should be tailored to meet specific needs.

NICE quality standards aim to help commissioners, health, social care and public health professionals and service providers improve the quality of care that they deliver by demonstrating high-priority improvement areas alongside a set of recommended measures. The postnatal care quality standard contains 11 statements to support the measurable improvement of services, most notably with regard to:

- ensuring mothers are aware of the health benefits of breastfeeding
- reducing the risk of sudden death syndrome
- assessing women for postnatal depression.

NICE quality standards are not mandatory but a healthcare system is obliged to have regarded them when planning and delivering services.

**To view a copy of the NICE quality standard on postnatal care visit http://guidance.nice.org.uk/QS37**

## Meningitis B vaccine rejected

The government body that advises the NHS on vaccine policy, the Joint Committee on Vaccination and Immunisation (JCVI), has decided that the meningitis B vaccine (Bexsero) will not be offered for routine childhood vaccination.

Licensed for use in January 2013, the vaccine protects against 73% of meningitis B strains in the UK and can be administered to infants aged two months or older. In a position statement, the JCVI argued that routine vaccination would not represent a cost-effective use of NHS resources. There was also concern that immunity may wear off over time.

Sue Davie, Chief Executive of Meningitis Trust/Meningitis UK, says: "This is extremely disappointing news after all our supporters' and our hard work over decades to introduce a vaccine."

## Is it cows' milk allergy?

A campaign by Mead Johnson Nutrition aims to raise awareness of the symptoms of cows' milk allergy (CMA) to parents and healthcare professionals (HCPs).

CMA is the most common food allergy in infants and young children. It may present with a wide variety of symptoms but it is important to recognise and manage CMA as early as possible, to help provide rapid relief of symptoms and ensure children receive a nutritionally adequate diet to support ongoing growth and development.

A survey of just over 2,000 mothers, commissioned by Mead Johnson Nutrition, revealed that diagnosis of CMA could take multiple appointments with a GP; the majority of parents visit their GP three to four times before a diagnosis is made.


A mother and her son who suffers with CMA.

The *Is it cows' milk allergy?* campaign aims to help parents and provide support for HCPs. Those HCPs wishing to learn more about CMA can view a series of educational resources including:

- CMA microsite (www.doctors.net.uk/cma)
- a Royal College of General Practitioners (RCGP) accredited module (www.doctors.net.uk/cma_ecme)
- free-to-attend continuing professional development (CPD) accredited educational events (www.allerni.co.uk).


## You said.... we did

Bliss, the special care baby charity, has produced a report that focuses on the importance of parent insight for improving neonatal care. *You said.… we did – meeting the promise of measuring parents' experience of neonatal care* highlights the need for neonatal units to pay particular attention to how parent experiences and perspective can be gathered and used to inform service planning and delivery.

The report draws on information from a national survey and consultation carried out by Bliss and concludes with a set of key recommendations to enable healthcare professionals to work in partnership with families to deliver a high quality service with improved outcomes for all.

**For more information email janea@bliss.org.uk**

## World Prematurity Day 2013

On Sunday 17 November, Bliss will join together with other international organisations to raise awareness for the 15 million babies that are born prematurely around the world each year.

The colour for World Prematurity Day is purple and this year Bliss would like as many people as possible to 'share a hug' and send in their photos via social media. It may be a parent's first cuddle with their baby, parents hugging each other for comfort or health professionals giving a parent a hug for support.

So dress in purple to show your support and help make a real difference to the lives of babies born too soon.

**For more information visit www.bliss.org.uk**

## Small drop in SIDS deaths 'not good enough'

Safer baby sleep charity The Lullaby Trust has called for urgent action to save babies' lives, as figures reveal that the decrease in the number of unexplained infant deaths in England and Wales has stalled.

The latest infant mortality figures from the Office for National Statistics show that there were 244 Sudden Infant Death Syndrome (SIDS) deaths in 2011, a reduction of only 17 from 2010. The Lullaby Trust's Chief Executive Francine Bates says: "We are extremely disappointed to see such a small, statistically insignificant reduction in the number of SIDS deaths. It's just not good enough. We continue to compare poorly with other countries in Europe which have managed to reduce their deaths more significantly."

Smoking in pregnancy is a significant risk factor for SIDS and it has been estimated that over 100 SIDS deaths could be prevented every year if pregnant women did not smoke. A report – Smoking Cessation in Pregnancy – published by the Smoking in Pregnancy Challenge Group led by The Lullaby Trust and the UK Centre for Tobacco Control Studies, shows how some health professionals lack training in smoking cessation techniques and discussing smoking with pregnant mothers.

**To see the report visit www.lullabytrust.org.uk/document.doc?id=313**

## Neonatal medicines mobile app


Health Education Thames Valley and Health Education Wessex have launched a neonatal medicines management app for use on smartphones.

Free to download, the mobile app is an interactive learning tool that enables staff caring for neonates to learn, practise, test themselves and enhance their knowledge of neonatal medicines management. The app uses content produced by local NHS neonatal nursing, pharmaceutical and medical experts ensuring that neonatal staff are using evidence-based best practice.

**For more information visit: www.workforce.southcentral.nhs.uk/libraries_elearning/elearning/mobile_ learning_for_the_nhs/neonatal_ medicines_mobile_app.aspx**

## A REaSoN to save the date

This year's REaSoN conference was a huge success with nearly 400 people attending over the two days. Ninety-eight per cent of delegates rated the event as excellent or good and most lectures were scored very highly – many achieving over 90% as excellent or good.

Comments from some of the delegates:

"A great overview of current and new therapies and time for networking."

"Probably one of the best REaSoN conferences that I have attended."

"I thoroughly enjoyed my first experience at REaSoN. It was interesting, sociable, and very eye opening. The speakers were knowledgeable and brought forward new thoughts that I will be happy to take to my unit."

"Wonderful event. Thought provoking, interesting, broad-based and balanced."

Save the date for next year's REaSoN: 30 June-1 July 2014.

REaSoN 2014

# Reflecting on intravenous drug administration: towards safer practice

Neonatal drug administration errors continue to be an escalating problem within NICUs. A strategy to enhance learning and hopefully reduce the number of adverse incidents reported was needed. A literature review was found to be of limited benefit in identifying tools to enable clinical staff to implement risk reduction. A locally developed education programme was successfully implemented resulting in a reduction in the number of intravenous drug administration errors. This article will share the evolution and implementation of this strategy in order to move towards safer practice.

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**Keywords**

IV neonatal drug administration; risk reduction; educational tool; simulation

**Key points**

**Kirk S., Cookson J.** Reflecting on intravenous drug administration: towards safer practice. *Infant* 2013; 9(5): 166-69.

1. Neonatal drug administration errors continue to rise but there is no appropriate educational tool to enable risk reduction.
2. Simulation can provide practical learning opportunities in a controlled secure environment.
3. An IV drug administration programme was implemented, which was well received and reduced the number of infusion errors.

Administration of medication is reportedly the highest risk task a nurse can perform, with accidental errors leading to devastating consequences for both the patient and the nurse's career[1]. Medication errors can be any incident where there has been an error in the following processes regardless of whether any harm occurred or was possible[2]:

- prescribing
- dispensing
- preparing
- administering
- monitoring
- providing medicines advice.

Medication errors have been likened to an iceberg, with only the tip being visible[3]. The National Patient Safety Agency[2] found that almost one in ten inpatients experienced medication-related harm, while Kaushal et al[4] found that potential adverse drug events occurred eight times more frequently on NICUs than in adult populations.

It is difficult to ascertain the number of administration errors in the neonatal unit environment. Much of the literature utilises differing definitions of error; looking particularly at administration errors can prove difficult. Locally there appears to be a perceived increase in medication errors, which could be due to the increasing workload of nursing staff; however this could also be due to a more robust incident reporting system. Nevertheless what is apparent is the cost, both financial and human, to patients and staff. Taken together with what is known of litigation costs, it is estimated that preventable harm from medicines costs more than £750 million each year in England[2]. Neonates are extremely vulnerable to medication errors due to their increased exposure to highly complex medications on the NICU. The effect on staff confidence and morale can be devastating following a medication error. It has been suggested that in a highly stressed neonatal environment, preventable errors could be one of the factors that cause nurses to leave the profession[5].

In seeking to devise an educational strategy to help reduce drug administration errors it was important to acknowledge the education neonatal nurses receive during their training. The Nursing and Midwifery Council (NMC) competencies for entry to the register were reviewed. Specific guidance relating to drug administration requests that: "All nurses must practise safely by being aware of the correct use, limitations and hazards of common interventions including the calculation and administration of medicines and the use of medical devices and equipment"[6]. The Royal College of Nursing (RCN) guidance on competencies in neonatal nursing was also reviewed. This guidance was developed in order to standardise training provided through higher education institutions to ensure practitioners who develop 'qualified in specialty' (QIS) status have the same knowledge and skills. Pertaining to the practice of drug administration, the document recommends that students are able to: "Demonstrate safe administration of relevant drugs in all situations, in

accordance with professional policies, and the ability to assess and evaluate responses"[7]. From personal reflection and enquiry with nurses working on the neonatal unit, it would appear that although significant education is provided during pre-registration nurse training on drug administration, the emphasis on neonatal-specific drugs and calculations seems to be minimal. Of those who have since developed QIS status, many have learnt the skills necessary to administer complex drugs in the clinical area. The question is whether this is enough to prevent administration errors in the clinical area.

## Background

A training need was identified following a meeting regarding a number of serious infusion errors on the NICU. In the preceding 12-month period there had been 21 reported incidents. These included all aspects of drug prescribing and administration. To address these needs the development of a non-threatening educational programme was deemed necessary. It was anticipated that in developing such a programme, staff confidence and morale would increase and the number of adverse drug errors would decline.

## Literature review

A search was implemented using the following keywords:

- drug administration
- continuous intravenous (IV) drug administration
- neonatal, newborn, infant, medication errors
- prevention and control
- nursing education programmes.

The CINAHL, Embase, Medline and PubMed databases were utilised and the search was restricted to articles from 2003-2013. Only original studies published in English were accepted.

The authors were seeking to obtain high quality evidence of a successful educational strategy to reduce medication administration errors on the NICU, yet the search provided guidance limited to practice-based articles with a primary focus on paediatrics (as opposed to neonatal nursing) and prescribing (as opposed to administration errors).

It has been found that three quarters of neonatal medication errors occurred at the prescribing stage[4]. Much of the literature focusing on strategies to improve medication safety revolves around ways to reduce these prescribing errors, such as computerised provider order entry (CPOE), ward-based pharmacists and bar coding[5,8].

Some of the literature offers explanations for administration errors, however there appears to be no identified solution to these issues. One study found that nearly one third of IV drug prescriptions on a neonatal unit were for doses that were less than one tenth of a single drug vial[9]. Ten-fold drug errors in prescribing are well documented and as such, there is great potential for serious administration errors. Furthermore, one in 20 of those doses was for less than one hundredth of a vial. A systematic review on the occurrence of errors in the preparation and administration of IV medication indicated that two stages of IV therapy had the greatest error probability; the reconstitution of the drug and diluent, and the administration of the drug[10]. These findings are confirmed as being the most vulnerable stages in the medicine administration process in another study[11].

Many of the available recommendations have already been implemented as good practice within the local neonatal unit including the double checking of medication[12], ward-based pharmacists and access to appropriate formularies[5,8]. It was identified that there was no specific area for drug preparation, which has now been rectified. Many of the recommendations within the literature focused on the need for continued education. In 2000 the Department of Health report, Organisation with a Memory[13], highlighted the need for reporting adverse events and ongoing investigation. Since then there have been numerous reports that have highlighted medication errors as an area for concern. However, there appear to be no dependable tools to enable clinical staff to implement risk reduction.

Medicine errors are unavoidable but they can be minimised by regular staff training[14]. Educational programmes in all aspects of medicine preparation and administration are recommended[15]. This could include opportunities for discussion away from the clinical environment, which might help to reduce the number of clinical incidents. The RCN competencies document suggested that the majority of human error could be minimised with the introduction of two main strategies: basic training complemented by regular updating on an annual basis and incident reporting within a culture of safety[16].

The available literature does not offer practical steps towards ensuring safe practice in administering medicines within the field of neonatology. When reviewing how best to implement the teaching of relevant practical skills, much of the work is embedded in Kolb's teaching theory on experiential learning[17]. It is now seen as an important domain in adult educational programmes where the aims are focused on the acquisition of practical skills.

One technique that is based on this strategy is that of simulation-based learning. Simulation can provide practical learning opportunities in a controlled secure environment. The idea of clinical simulation has been around since the 1980s[18]; historically it has been used to teach psychomotor skills such as injections and catheterisation. It ensures that a safe learning environment is provided in which learners respond to a predetermined clinical situation. However, the role of clinical simulation in the ever-changing healthcare system is adapting to meet required cognitive and affective skills, such as clinical judgement and decision making.

Safe drug administration is an ideal concept to incorporate into a simulated working environment. It is often seen as a basic nursing task when in fact it requires complex interaction of a large number of specific dimensions and actions, utilising appropriate clinical judgement skills as well as effective team working abilities. When coupled with the intensity of the clinical setting in the neonatal intensive care area, it is understandable how mistakes can occur.

By offering simulated clinical scenarios in a controlled, safe environment it is proposed that an upsurge in an individual's self confidence will ensue[19]. This is of vital importance as it has been suggested that if nurses lack confidence there is a high risk of errors[15].

## Responding to need

In the absence of a suitable educational tool, a locally developed educational programme was devised. The programme needed to be a holistic package that would cover the complete journey from prescription accuracy, dispensing, preparation and ultimately administration of the correct drug to the correct patient. The journey was broken down into specific

| |
|---|
| Identify personal and professional accountability in the administration of IV therapy in relation to the NMC professional code of conduct |
| Discuss the principles of asepsis in IV therapy |
| Demonstrate the safe preparation of IV drugs |
| Be able to identify hazards associated with IV therapy and the administration of IV drugs |
| Demonstrate the accurate calculation of drug dosage |
| Demonstrate the accurate preparation of a continuous drug infusion |

**TABLE 1** Learning outcomes for the education programme.

learning outcomes (**TABLE 1**), which formed the basis for the objectives and the educational tool.

This programme was aimed at the QIS members of the neonatal team, irrespective of their seniority and years in service. It was appreciated that this would generate apprehension and significant stress to those involved.

To begin the process there were informal discussions within the multidisciplinary team. A pre-course learning package was drafted, which was evaluated at a focus group that included senior neonatal nurses. Adjustments were made following successful feedback. The pre-course workbook included a chapter on each aspect of the identified learning outcomes and was designed to reaffirm skills and knowledge already utilised in the clinical setting. This was intended to allay apprehension surrounding the workshop scenarios. The workbook helped the participants to identify the learning outcomes prior to the session, as well as giving a wealth of information pertaining to relevant issues surrounding IV administration. When the workbooks were launched each nurse candidate was allocated a mentor for support during the process.

A set of four skill stations were formulated that addressed issues particularly pertinent to the neonatal unit at the time. The drugs used in these skill station scenarios were:

1. Adrenaline infusion
2. Double strength dobutamine infusion
3. Vancomycin infusion
4. Bolus dose hydrocortisone.

These drugs were chosen due to the high risk of potential error associated with their preparation and administration. Development of these critical thinking skills would be transferable to other drugs and their administration.

The skill station scenarios were facilitated within the education centre away from the neonatal unit. This ensured a controlled environment and enabled the candidates to focus entirely on the scenarios rather than clinical responsibilities. The unit manager supported this and ensured that these hours were included within the nurses' working hours.

The workshop commenced with a presentation by the neonatal unit pharmacist and course facilitator. This consolidated the theoretical component by reviewing the contents of the workbook and answering any unresolved questions.

Two members of the focus group facilitated each skill station, which comprised an everyday task starting with the IV prescription and ending with the administration of the drug. All of the stations had the necessary resources to complete each scenario thoroughly, including relevant drug information and the appropriate infusion pumps to ensure that the device was set accurately to administer the drug. Candidates were allocated to work in pairs therefore mimicking the real life clinical environment. Throughout the workshop the candidates visited all four skill stations; there was an expectation that candidates would discuss and demonstrate each step of the process. Each skill station was assessed using the competency document. This contained five broad areas which required consideration and review:

1. Checking prescription accuracy
2. Utilisation of available resources
3. Calculation of the prescription
4. Practical dilution of the drug
5. Preparation and completion of the drug infusion label.

No time limit was set although 30 minutes was allocated to each skill station; this was found to be more than adequate in most cases. The course facilitator was always on hand to step in if a candidate needed additional support during the workshop. If an issue arose that could not be resolved at the time, the candidate could work with their mentor to clarify the problem then work through the issues identified, ultimately ensuring the competencies were safely achieved.

Following the successful completion of the workshop, candidates received a certificate to add to their portfolio.

## Evaluation

As this educational tool was newly devised, evaluation was of high importance. A pre- and post-workshop evaluation form was used. The evaluation tool utilised the Likert scale to assess a candidate's feelings around the skill station workshop.

It appeared that candidates had limited training on IV drug administration to neonates prior to the workshop. Many lacked confidence when both preparing and calculating IV infusions for administration. Following the skill station scenarios over 90% of candidates felt that their confidence in dealing with the preparation and calculation of IV infusions had increased. Six months after the skill station scenarios, a further evaluation was conducted, to which there was an 88% response rate. Ninety per cent of those who responded still felt that they were confident in the preparation and calculation of IV infusions for administration to neonates.

Moreover following completion of the programme, it was essential to review the effect on the number of clinical incidents reported surrounding IV infusion administration. In liaising with the ward-based pharmacist it was found that no infusion errors had been reported in the ensuing nine months. There had been seven drug-related errors, all of which were connected to oral drugs rather than IV drugs.

## Discussion

There was a great learning curve for everyone involved in the workshop scenarios. Upon discussion with senior members of the nursing team, who attended the workshop as candidates, a range of anxieties was evoked. However, upon reflection, the benefit to clinical practice was acknowledged and as more candidates successfully completed the scenarios these levels of anxiety appeared to diminish as positive feedback from their colleagues emerged.

Initially the course facilitator thought

that this was going to be a short and simple task. However, the workbook grew into a workshop scenario session which then grew into ongoing annual sessions. It has also been incorporated into curriculums within local higher education institutions and training programmes at a network level. In hindsight, the project was much larger than initially anticipated, the time required to set up such a programme was under estimated. In the future any further projects should have a realistic time allotted to them.

Although this initial pilot project was developed for QIS staff with specific IV drugs pertaining to the intensive care unit, there has since been a workshop developed for non-QIS staff, which follows the same format but utilises common bolus IV drugs that these nurses are expected to administer on a daily basis. This will aid their continuing professional development and has now been recommended and accepted as part of the training culture on the unit, such that the sessions will become part of the annual mandatory training. This has received support from the management team on the unit, as there is now evidence that this educational approach has resulted in a significant reduction in the number of administration errors.

To effectively evaluate the impact of implementing such an educational strategy the authors acknowledge the importance of a robust mechanism for reporting administration errors. This plays a pivotal role in improving the medication management process. Education about a nurse's legal and moral obligation to report such incidences needs to be reiterated to ensure that units capture true data. There is a need to ensure that a culture of safety is fostered in which there is a shift in focus from counting the number of errors to a more proactive approach – developing a preventable strategy. It is anticipated that more transparency in terms of reporting will be attained if nurses understand that the information will help to underpin future development of such educational strategies. This will help prevent further errors and help us as a profession to learn from common errors identified. It is recommended that health professionals work together from a network perspective to capture true clinical data pertaining to drug administration errors and provide support to the multidisciplinary team for such educational strategies. An audit would be beneficial to review the impact on a larger scale on clinical practice.

The NMC states that nurses are: "Accountable for any actions and omissions in [their] practice and must always be able to justify [their] decisions"[20]. The workshop enables the nurse to fulfil aspects of the code with regards to keeping up-to-date and improving knowledge and competency. Nurses have numerous responsibilities when involved in administering IV medications. Not only is it essential to protect themselves from making errors but also to identify and deal with any errors made by the prescriber[21]. It remains a high-risk area for nursing practice and a matter of concern for practitioners, policymakers and families.

## Conclusion

In reviewing the literature it was discovered that there is a paucity of evidence of a successful educational strategy to reduce medication administration errors on the NICU. There was no research that identified best practice for ensuring safe administration of IV medications or for dose calculations for nurses. Many of the studies were focused on paediatric populations. It is therefore suggested that further research is undertaken to investigate issues relevant to the neonatal population.

Pressures to reduce the number of risks in the intensive care environment have resulted in the need to ensure a safety conscious culture. Clinical simulation is an ideal approach to embrace this ethos as it allows a risk-free approach to learning. The idea of integrating task orientation and team working skills in an environment that closely replicates the clinical working environment has enhanced performance and has reduced errors.

## Acknowledgement

The authors would like to thank Hayley Atkin, Women and Children's Pharmacist, for her invaluable role in developing and delivering the teaching package.

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# Should we use olive oil or sunflower oil on a preterm infant's skin?

Many health professionals recommend olive oil as a topical emollient for infant skin regardless of gestational age. A preterm infant's skin has a much thinner protective skin barrier than a term baby. The use of olive oil, which is high in oleic acid, has a damaging effect on the skin's protective barrier and therefore may further compromise the well-being of an already vulnerable baby. Alternatively, highly refined sunflower oil, which is very low in oleic acid, has positive antibacterial, moisturising and regenerative properties on the skin's protective barrier.

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**Keywords**

olive oil; sunflower oil; neonatal; premature; oleic acid; SCBU

**Key points**

**de Meza T.** Should we use olive oil or sunflower oil on a preterm infant's skin? *Infant* 2013; 9(5): 170-72.

1. Many health professionals recommend olive oil for emollient use on preterm and term infants' skin.
2. At 32 weeks' gestation, a baby's skin is immature and the protective skin barrier is thin.
3. The main constituent of olive oil is oleic acid, which can damage the stratum corneum.
4. Sunflower oil is very low in oleic acid and has properties that enhance the stratum corneum.
5. A review of practice guidelines is suggested to include recommendations for preterm infants' skin

This article arose from observations by a student midwife during a practice placement on a special care baby unit (SCBU). While caring for premature twins, a clear bottle containing a straw-coloured liquid was noticed among their belongings. The bottle had no label identifying either its ingredients or the infants' names. A neonatal nurse confirmed that the bottle belonged to the twins and it contained olive oil for their parents to use as a massage or touch medium. Not only was it extremely unsafe to have an unidentifiable bottle of liquid within the SCBU, but also literature suggests that olive oil should no longer be used on the skin of premature or term infants[1,2]. Staff in the unit commonly recommended olive oil yet they had no written guidelines in support of its use.

The author conducted an informal survey of neonatal units across London to find out which oils were recommended for use. Of the 24 London hospitals verbally contacted, 19 stated that they used olive oil on the skin of preterm infants, either as an emollient or massage medium.

## The role of the healthcare professional

The Nursing and Midwifery Council (NMC) code states nurses/midwives have a responsibility to ensure that all care, advice and information they provide is supported by up-to-date available evidence, which includes advice pertaining to the use of products[3]. For this reason, it is unacceptable to provide care based only on tradition and routine. For health professionals to be able to provide suitable skincare advice, it is necessary to first have a clear understanding of the anatomy, physiology and function of human skin. It is also crucial to have an understanding of the differences between the skin of a baby born at term (**FIGURE 1**) and that of a baby born prematurely (**FIGURE 2**).

## Structure and function of the skin

The skin is the largest organ of the human body, possessing a variety of essential functions. Its primary function is to act as a protective barrier against external pathogens and environmental allergens, toxins and irritants. In addition it acts as a sensory organ to touch, pressure and temperature and also maintains thermoregulation, prevents dehydration and helps in the elimination of waste products. Skin consists of three main layers:

1. The epidermis, the outermost layer
2. The dermis, the middle layer
3. The hypodermis, a deep layer of subcutaneous fatty tissue.

The stratum corneum – the 'skin barrier' – is the most superficial layer of the epidermis. Exposed at the surface of the skin, the stratum corneum is made up of keratinocytes surrounded by lipid layers in a formation comparable to bricks and mortar; the bricks representing the keratinocytes and the mortar the surrounding lipid layers[4].

## Structure of a neonate's skin

Babies born at term (37-42 weeks' gestation) have a skin structure resembling

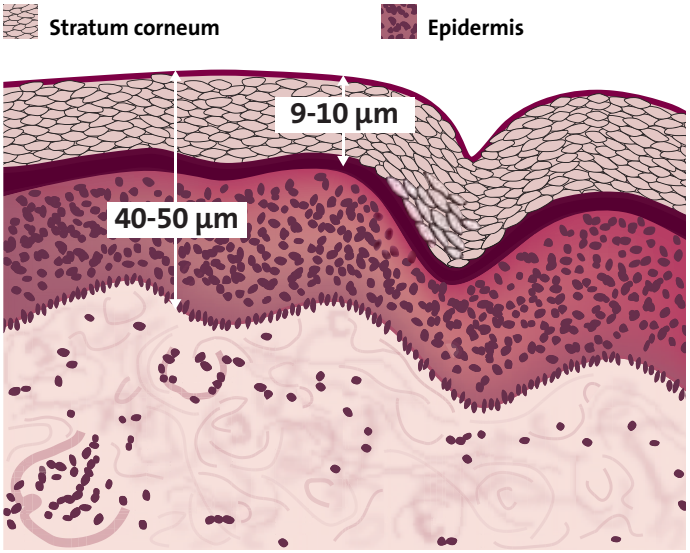


**FIGURE 1** Full-term neonatal skin.

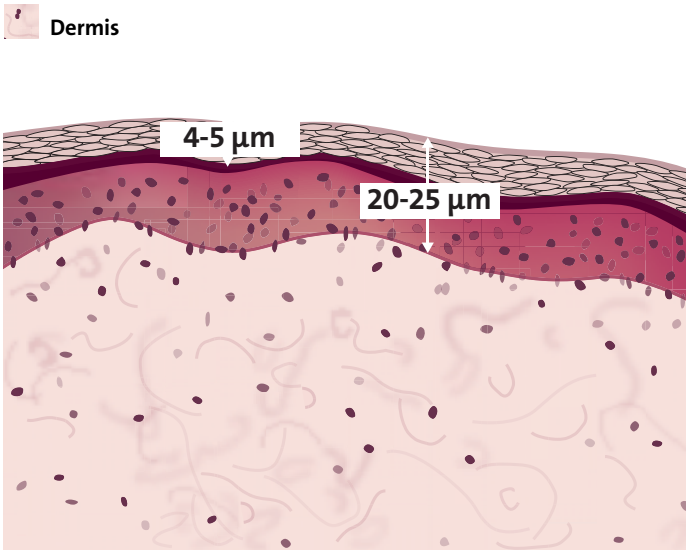


**FIGURE 2** Fetal skin at 25 weeks' gestation.

that of an adult however, a baby's skin is more vulnerable and less mature than adult skin. The stratum corneum and the epidermis are much thinner and contain fewer lipid layers, resulting in increased permeability, increased rate of transepidermal water loss (TEWL) and therefore reduced barrier function[5]. Premature infants have immature immune systems, contributing to their continuous risk of infection, and their skin barrier status is dependent on their gestational age at birth[6]. At approximately 32 weeks' gestation the layers that make up the epidermis are complete but still very immature, with the stratum corneum only 2-3 cells thick[7]. Consequently, extra special care should be taken to preserve the integrity of their skin to reduce the risk of acquired infections[8].

Neonatal skin undergoes a progressive adaptation to the extra-uterine environment. The skin of a newborn baby born at term has a pH of 6.34, which reduces to approximately 4.95 in the days following birth, to around 4.7 over the following month[9]. The low pH of the skin surface creates an 'acid mantle' that helps protect against potentially harmful bacteria. Maintaining this pH is essential for providing a protective barrier function and for the maturation of the stratum corneum.

Due to the increased rate of TEWL in both premature and term infants, the skin becomes dry in the neonatal period and goes through a process of desquamation[7]. The skin barrier continues to develop and is not fully mature until 12 months following birth[10]. As a neonate's body surface to body weight ratio is higher than an adults, their skin has increased vulnerability to the use of topical agents[11].

## Literature review: olive oil or sunflower oil?

Baby massage has been practised for centuries in many cultures worldwide. 'Positive touch' is a therapy designed to allow parents of premature infants the precious opportunity to have gentle, loving contact while in the special care baby unit[12]. Oil is used as a lubricant to prevent friction of the skin. Research demonstrates that positive touch therapy enhances the emotional development and weight gain of the preterm infant and also promotes maternal-infant attachment[13].

The National Institute for Health and Care Excellence (NICE) postnatal care guideline does not mention or recommend oils for use on a baby's skin, whether preterm or term[14]. Despite this, a qualitative study discovered that many mothers use olive oil on their babies' skin, as it is recommended by health professionals as an emollient to alleviate dry skin in the early neonatal period[15]. There is no available evidence to support the use of olive oil.

When vegetable oils are used for topical application on the skin they penetrate the stratum corneum[16]. Various research studies have revealed that oils containing high concentrations of oleic acid can damage the skin's protective barrier[17,18]. Even small amounts of oleic acid disrupt the lipid barrier in the stratum corneum, which consequently causes increased skin permeability, inducing skin barrier breakdown. The main constituent of olive oil is oleic acid, comprising 55-85% of the oil[19].

Based on these research findings an international clinical expert group in paediatric dermatology stated that the use of olive oil as a topical medium on the skin of babies should be avoided[1]. Similarly, the International Association of Infant Massage (IAIM) does not recommend the use of olive oil for infant massage[2]. However, a recent survey of maternity and neonatal units in the UK found that olive oil was the most widely recommended oil with 81.6% of the units recommending its use as an emollient or for positive touch therapy[20].

In contrast to the high percentage found in olive oil, sunflower oil has only 16-19% oleic acid and is comprised mostly of linoleic acid (68-72%)[21]. Sunflower oil mirrors skin lipids, resembling the naturally occurring sebum in human skin. It has regenerative, restructuring and moisturising properties due to its high essential fatty acid content, namely the linoleic acid that enhances the skin barrier[22]. Studies on mice revealed that a single application of sunflower oil on damaged skin significantly accelerated skin barrier recovery within one hour of application, with the effect still visible five hours later[18]. Comparable findings were discovered regarding the anti-bacterial effect of sunflower oil and its ability to restore the intracellular lipids, reducing the occurrence of dermatitis[23]. However, it was noted that the risk of nosocomial infections was increased and therefore it was advised that emollients should not routinely be used on premature infants. In

contrast, research studies conducted within neonatal units in Bangladesh and Egypt found that the topical use of sunflower oil on preterm infants considerably improved skin condition and dramatically reduced the incidence of nosocomial infections and mortality[24-27].

Refined oil is free from impurities, thin in texture, has almost no smell and has a longer shelf life[28]. The refining process destroys allergen-bound proteins, reducing the risk of allergic reaction[29]. Consequently, highly refined sunflower oil is safe, non-toxic and recommended for use on premature infants' skin for positive touch therapy[12,30]. Comparatively, cold-pressed oils are not sterile and as such may contain bacteria and fungal spores, which may grow when they have access to moisture on the skin[31].

## Summary and recommendations

Research carried out over the last 15 years has revealed the damaging effects of olive oil on the skin barrier. The skin of an infant born at term is not fully mature until at least 12 months of age and a preterm infant's skin is far more vulnerable. Despite the wealth of evidence that promotes the benefits of sunflower oil, too many health professionals still recommend olive oil as a topical skin emollient for all infants.

Substantial research has revealed the benefits of topical use of sunflower oil on a preterm infant's skin. It has been found to promote barrier function and reduce bacterial infections, so much so that a clinical expert group in paediatric dermatology and also the IAIM no longer recommend the use of olive oil[1,2]. Highly refined oil is safer to use, as it is unlikely to cause a skin allergy. In order to ensure that the use of sunflower oil in the hospital setting complies with current safety measures, all bottles should be manufactured, labelled and provided by the hospital to avoid any risk of contamination or the illegal practice of decanting oil into unsuitable containers.

Highly refined food-grade sunflower oil is used in the SCBUs of two London hospitals. The clear, pale yellow, odourless oil is manufactured in the UK and bottled and labelled within a UK hospital pharmacy[12]. It is supplied in small 50mL plastic bottles to prevent it from becoming rancid; bottles are not meant to be shared and therefore should be labelled with each baby's identity.

Fractionated coconut oil is also recommended for topical use on preterm infants in the SCBU as an alternative to sunflower oil[12], however further empirical research should be undertaken to support its use. In order to initiate a change in current practice, the author recommends that NICE review its postnatal guidance to include recommendations for preterm infants' skin.

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# Beta-casein proteins and infant growth and development

Milk formula is usually based on cows' milk with the addition of essential nutrients and vitamins. A major protein component of cows' milk is β-casein of which there are two primary variants, A1 and A2. Studies have linked a digestive product of A1, but not A2, to an increased risk of type 1 diabetes in some infants, adverse immune responses, digestive disorders and respiratory dysfunction. The A2 protein is more comparable to human β-casein protein. Formula based on the A2 protein, excluding A1 protein, may more closely mimic breast milk and may help to maintain optimal growth and development in the infant.

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## Keywords

cows' milk protein; caseins; β-casomorphin-7; type 1 diabetes; digestive disorders; respiratory dysfunction

## Key points

**Sadler M.J., Smith N.** Beta-casein proteins and infant growth and development. *Infant* 2013; 9(5): 173-76.

1. The A2 variant of β-casein in cows' milk is structurally more comparable to the β-casein protein in human breast milk.
2. Digestion of A1 yields BCM-7, which is associated with adverse effects including increased risk of type 1 diabetes, intolerance reactions and digestive disorders.
3. Levels of BCM-7 derived from A1-containing formulae in infants correlate with delays in psychomotor development and respiratory dysfunction.
4. Consumption of an infant formula containing only A2 β-casein may help to maintain a range of functions in growing and developing infants.

Breast milk is the preferred source of nutrition for infants. The World Health Organization (WHO) recommends that infants should be exclusively breastfed for the first six months of life and that breastfeeding should be continued for up to two years or beyond, together with appropriate solid foods[1]. However, not all infants can be breastfed and some may not have access to donor breast milk. In such situations, the family will need to use infant formula instead. Most infant formulas are produced from cows' milk as it is a relatively cheap source of protein and nutrients and is abundantly available. However, the protein composition of breast milk differs substantially from that of cows' milk. For example, breast milk is whey dominant, with approximate casein to whey ratio of 40:60, ranging from 10:90 in early lactation to 50:50 in late lactation. In contrast, cows' milk and infant formula have casein to whey ratios as high as 80:20[2].

β-casein is a major protein expressed in human and cows' milk and is present in many food products derived from milk. Like other proteins, β-casein is an important source of amino acids and facilitates mineral transport, but can be broken down into smaller bioactive peptides. In cows' milk, two primary variants of β-casein, termed A1 and A2, and several rare sub-variants have been identified. A1 and A2 β-casein differ in their protein structure by a substitution of the amino acid at position 67 (**FIGURE 1**). A1 β-casein contains a histidine residue at position 67, which allows cleavage of the preceding seven amino acid residues, generating the peptide β-casomorphin-7 (BCM-7). A2 β-casein contains a proline residue at position 67, which prevents cleavage of this peptide[3]. The protein structure of β-casein in breast milk is similar to that of A2 β-casein in cows' milk (**FIGURE 2**) and hence human β-casein is not susceptible to this mode of cleavage.

BCM-7 has a demonstrated potential to cross the gastrointestinal wall, enter the systemic circulation and influence systemic and cellular activities via opioid receptors. Moreover, BCM-7 and other derivatives of β-casein are potent exogenous agonists – exorphins – for opioid receptors, with the greatest affinity for μ receptors[4]. Consequently, BCM-7 has the potential to influence the activities of a variety of organs/systems, notably the digestive system and immune cells. It may also be involved in various disorders in infants, including type 1 diabetes[5] and respiratory dysfunction[6], and may influence central nervous system activity[7].

## A1-derived BCM-7 and the digestive system

It is reported that chronic constipation and the development of anal fistulas in infants are significantly associated with the volume of cows' milk consumed and a shorter duration of breastfeeding[8]. This phenomenon may be related to the

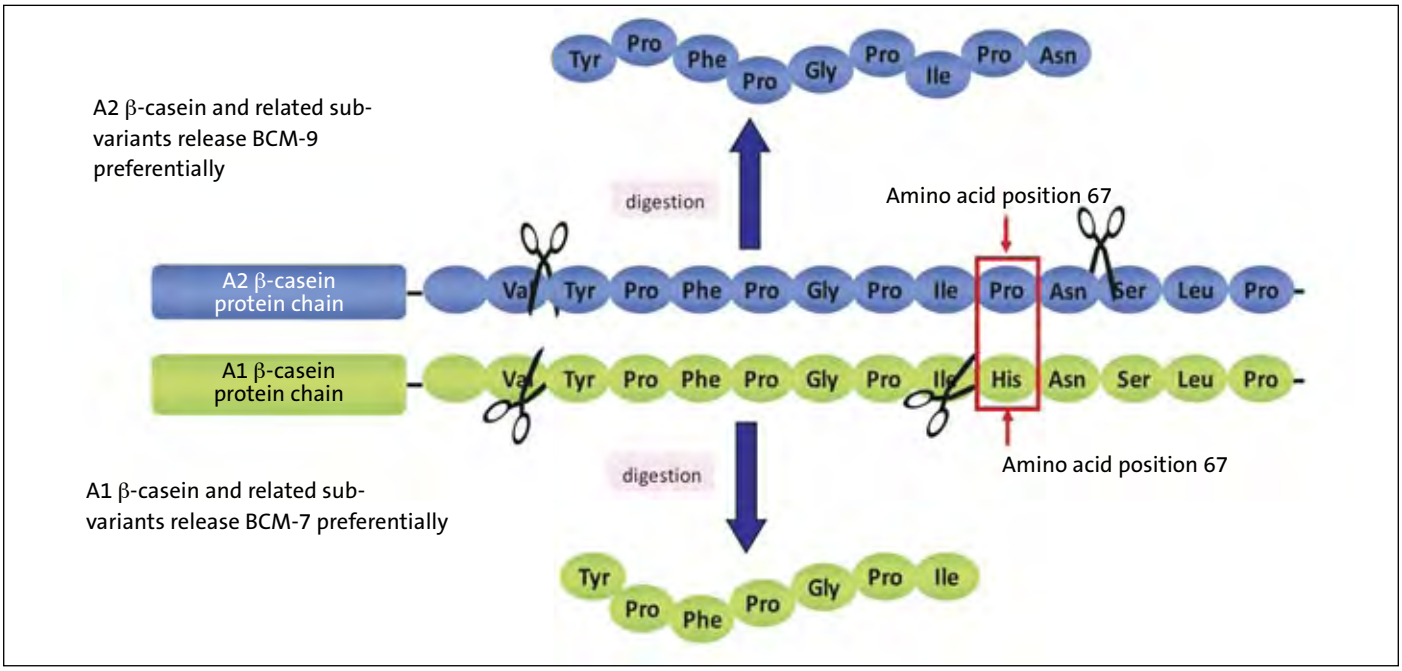


**FIGURE 1** Cleavage of A1 β-casein at position 67 yields the peptide β-casomorphin-7 (BCM-7).

morphine-like effects of BCM-7[9,10].

The digestive tract of infants is very immature, particularly in terms of enzyme expression profiles and commensal bacteria[11], and undergoes continual development from birth to weaning[12]. Because proteins are principally digested in the intestinal tract in infants, rather than in the stomach as in adults, the likelihood of incomplete digestion of β-casein to amino acids is much greater in infants. Furthermore, the neonatal gut is designed to absorb relatively large macromolecules, particularly lactoglobulin (the main whey protein) from breast milk. A consequence of these essential features of the infant gut may include increased generation and uptake of BCM-7, which may adversely affect the functions of the digestive tract by slowing gastrointestinal transit, altering mucus secretion and facilitating the development of anal fistulas. The protein fragments may also have important roles in adverse immunological and allergic reactions[13].

## A1-derived BCM-7 and immune function

While the immunomodulatory effects of morphine are generally well established, the potential immunomodulatory effects of β-casein and its cleaved peptides were first identified in the 1980s[14,15]. Since then, it has become apparent that exorphins, including BCM-7, have immunomodulatory properties. For example, BCM-7 was reported to trigger histamine release from peripheral leukocytes[16] and to stimulate secretion by peritoneal mast cells[17]. Studies have shown that BCM-7 alters lymphocyte proliferation *in vitro* through a pathway mediated by opiate receptors[18,19]. The first of these studies showed suppressive effects of BCM-7 on lymphocyte proliferation at all concentrations tested[18], while the second study showed suppressive effects of low BCM-7 doses and stimulatory effects at higher doses[19].

Clinically, BCM-7 may induce allergic reactions by stimulating excessive histamine release, which may lead to localised 'pseudoallergic' skin reactions or airway inflammation[16,20]. Impaired immune function may also increase susceptibility to infection and other potentially severe diseases, as has been reported for morphine[21]. Additional studies are needed to establish the specific immunomodulatory effects of BCM-7 and related peptides and to determine their clinical implications. Intervention studies are also warranted to assess whether the potential for these adverse events may be avoided by excluding A1 β-casein from the diet.

| | |
|---|---|
| Tyr$^{60}$-Pro$^{61}$-Phe$^{62}$-Pro$^{63}$-Gly$^{64}$-Pro$^{65}$-Ile$^{66}$-His$^{67}$ | Bovine β-casein A1 |
| Tyr$^{60}$-Pro$^{61}$-Phe$^{62}$-Pro$^{63}$-Gly$^{64}$-Pro$^{65}$-Ile$^{66}$-Pro$^{67}$ | Bovine β-casein A2 |
| Tyr$^{51}$-Pro$^{52}$-Phe$^{53}$-Val$^{54}$-Glu$^{55}$-Pro$^{56}$-Ile$^{57}$-Pro$^{58}$ | Human β-casein |

**FIGURE 2** Sequence comparisons of A1 and A2 β-casein in cows' milk and the corresponding sequence in human β-casein.

## A1 β-casein and type 1 diabetes

Type 1 diabetes is characterised by autoimmune-mediated destruction of pancreatic  cells. Its incidence is progressively increasing in many countries[22,23]. One explanation is that environmental factors play a major role in its pathogenesis[24].

A link between cows' milk and type 1 diabetes in animals was first reported in 1984[25], while a link to type 1 diabetes in humans was first reported in 1990[26]. A subsequent study proposed that early exposure to cows' milk may increase the risk of type 1 diabetes by approximately 1.5 times[27]. Since then, several published studies have supported this association[28-30], although other studies have found no association between antibodies to cows' milk and the risk of type 1 diabetes[31-33].

The identification of A1 and A2 β-casein and the increased understanding of their differing effects on immune function prompted the hypothesis that the discrepancies in epidemiological findings may be, at least partly, attributable to the main type of β-casein consumed in each country. In 1999, in an analysis of children aged 0-14 years across 10 countries/regions, it was reported that, while total cows' milk protein consumption (including from dairy foods) was not significantly

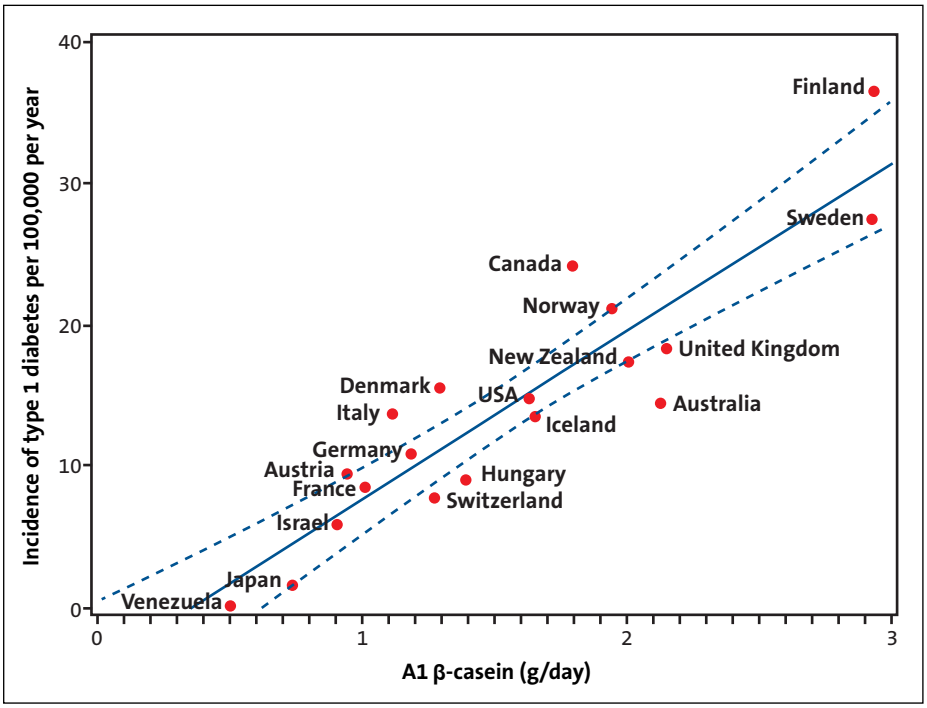


**FIGURE 3** Correlation between A1 β-casein supply per capita in 1990 and incidence of type 1 diabetes (1990-1994) in children aged 0-14 years in 19 countries (r=0.92; 95% confidence interval 0.72-0.97; p<0.0001). The dotted lines show the 95% confidence limits of the regression line. Data from Laugesen and Elliott (2003)[35].

correlated with the incidence of type 1 diabetes (r=0.402), there was a correlation with the consumption of A1 β-casein (r=0.726)[34]. These findings were confirmed by two other independent studies involving a larger number of countries/regions (**FIGURE 3**)[35,36]. A study published in 2006 provided further support for the diabetes-producing effects of A1 β-casein[37].

To better understand the relationship between A1 β-casein and risk of diabetes, Birgisdottir et al compared the risk of type 1 diabetes among children and adolescents in Iceland and Scandinavia[37]. The consumption of A1 β-casein was calculated from milk and milk products consumption data and cows' milk protein concentration. A significant difference was found between the calculated intakes of A1 β-casein in two-year old children in Iceland, compared to Scandinavia. Consumption of A1 β-casein at this age was lower in Iceland than in Scandinavia and correlated with the incidence of type 1 diabetes in 0-14 year-old children (r=0.9, p=0.037). There was no difference in consumption of A1 β-casein in 11-14 year olds and no association with the incidence of type 1 diabetes in this age group. While not demonstrating cause and effect, these observational data suggest that avoiding the consumption of A1 β-casein during infancy and early childhood may reduce the risk of developing type 1 diabetes in adolescence.

## A1-derived BCM-7 and respiratory function

Peptides derived from casein, including BCM-7, have been implicated in the aetiology of sudden infant death syndrome[6]. For example, Wasilewska et al noted that infants with apparent life-threatening events had higher serum levels of BCM-7 after apnoea compared with healthy infants of the same age[38]. Similar findings were reported for other BCMs and β-endorphins[39-41]. Hedner and Hedner noted that BCMs can readily cross the blood-brain barrier in newborn rabbits and cause dose-related depressions of respiratory frequency and tidal volume[42]. They found that BCM-7 was equipotent to morphine and its effects were reversed or prevented by naloxone, a μ-receptor antagonist.

## Role for milk formula based on A2 protein

There are some data to suggest that consumption of dairy products containing predominantly A1 β-casein may be associated with adverse clinical outcomes in some susceptible infants and young children, including digestive disorders, immune disorders, type 1 diabetes and respiratory dysfunction. By contrast, infants who are mainly given breast milk, which contains β-casein that is more comparable in terms of structure and digestion patterns to A2 than to A1 β-casein in cows' milk, are at a lower risk of developing these disorders. While further research is warranted, for infants requiring milk formula because of limited availability of breast milk the data published to date suggest that milk formula (and dairy products in older infants) excluding A1 β-casein may help to reduce the risk of a range of adverse effects or reactions.

## Conflict of interest and acknowledgement

This review was made possible by a grant from the A2 Corporation Ltd (Auckland, New Zealand). The authors would like to acknowledge the medical communications branch of Edanz Group Ltd (Hong Kong) for assistance with literature research associated with bovine A1/A2 β-casein consumption.

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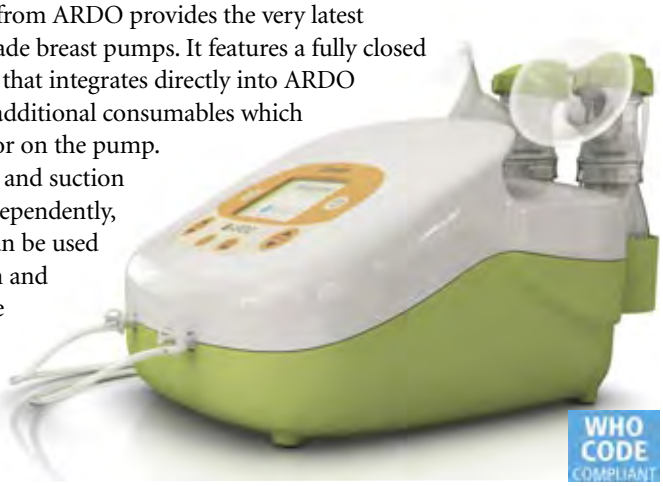


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Cost: £35

Contact: www.infantandtoddlerforum.org/study-day-2013

## 6 NOVEMBER 13

### Basic Neonatal Ventilation Workshop

This workshop is aimed at neonatal nurses and midwives as well as junior doctors starting in neonatology.

Venue: Holiday Inn, Glasgow Airport

Cost: £70

Contact: Rob Bullen
Tel: 0800 9177 405
rob@cfsevents.co.uk
www.cfsevents.co.uk

## 11 NOVEMBER 13

### Leeds Symposium on Nasal High Flow Therapy

Date for the diary.

Venue: Thackray Museum, Leeds

Contact: Vapotherm
johnnash@vtherm.com

## 13 NOVEMBER 13

### Advanced Neonatal Ventilation Workshop

This workshop is aimed at consultants, specialist registrars, senior house officers, ANNPs and senior nurses.

Venue: Holiday Inn, Glasgow Airport

Cost: £70

Contact: CFS Events Ltd
Tel: 0800 9177 405
wendy@cfsevents.co.uk
www.cfsevents.co.uk

## 13-14 NOVEMBER 13

### RCM Annual Conference

The Royal College of Midwives annual meeting. Speakers will include senior politicians, international and UK midwifery and maternity experts and leading thinkers in health policy.

Venue: Telford International Centre, West Midlands

Cost: Varies

Contact: Tel: 0207 880 6225
natalie.dowell@redactive.co.uk
www.rcmconference.org.uk

## 20 NOVEMBER 13

### National Action and Good Practice Conference

A conference hosted by Bliss to celebrate achievement and best practice in family-centred care.

Venue: Friends House, Euston, London

Cost: The event is free but places are limited.

Contact: Bliss
Tel: 0207 378 1122
innovations@bliss.org.uk
www.bliss.org.uk

**If you would like to promote a study day or conference on this page free of charge, email details to lisa@infantgrapevine.co.uk**


# Oxford University Hospital Cares for Neonatal Nurses

**Based within the John Radcliffe Hospital in Oxford, OUH Neonatal Unit benefits from its proximity to world-leading cardiovascular and neuroscience centres and a state-of-the-art children's hospital meaning the best help and support is just a walk away. Affiliated to the University of Oxford the unit benefits from leading-edge research and technology and is involved in many clinical trials.**

Our permanent staff have developed a strong support culture within the unit. Joining our team will make you part of a unique family.

OUH Neonatal Unit is one of the largest tertiary neonatal centres in the UK accepting referrals from near and far. Our on-site transport services are a vital link with other units throughout the country and sometimes beyond!

**Due to continuous expansion of the Neonatal Unit at the John Radcliffe Hospital in Oxford we have vacancies for permanent band 5 and 6 nurses.**

Previous experience of working in a neonatal environment is essential. We offer comprehensive orientation and peer mentoring to ensure new members of our team feel welcomed from day one. We encourage continuous development through evidence-based nursing by offering the neonatal course. Help with relocation is available.

OUH is serviced by excellent public transport links and easily commutable from towns and villages within a 20-mile radius of Oxford City Centre.

Find out more about these exciting opportunities and apply to join us at:

**www.oxfordneonatalcare.co.uk**

Oxford University Hospitals NHS
NHS Trust

***OUH Neonatal Unit***

St George's Healthcare NHS
NHS Trust

## NEONATAL UNIT

The Unit is the Lead Centre for South West London Perinatal Network and a tertiary referral centre for neonatal surgery with a capacity of 39 cots, 12 of which are intensive care, nine high dependency and 18 special care. The unit also provides a neonatal community follow-up service and has a large establishment of 160 nurses and support staff, ranging from Neonatal Assistants to Advanced Neonatal Nurse Practitioners.

### Matron – Band 8a

Reference number: 200-CWJLF-637-NJ

You will have robust and proven track record of clinical excellence, managerial leadership and a strong focus on driving high standards to direct the clinical team on this busy tertiary referral centre. Relishing the opportunity to lead by example and demonstrating excellent people management skills, you will lead the operational issues of the unit, inspire and motivate nurses and be the custodian of the patient experience. In return we can offer you the opportunity to further develop personally and professionally to achieve your full potential. You must be NMC registered and in possession of a neonatal and mentorship qualification with a minimum of 5 years recent experience at a Band 7 ward manager and above.

### Sister – Band 7

Reference number: 200-CWJLF-609-NJ

We are looking for a skilled neonatal nurse with excellent communication skills and proven evidence of leading and supporting the team on a shift basis to deliver high quality care to sick premature babies. You must be NMC registered and in possession of a neonatal and mentorship qualification with a minimum of 3 years recent experience at Band 6.

**For further information or to arrange an informal visit for these posts, please contact Doris Jackman, Head of Nursing Newborn Services on 020 8725 1342 or 020 8672 1255 on air call SG 102.**

**To apply for these posts, please visit www.jobs.nhs.uk**

**Closing date: 30 September 2013.**

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**www.show.scot.nhs.uk/nhsfv**

NHS Forth Valley

**Women & Children's Unit**

## Advanced Neonatal Nurse Practitioner

**Full-time 37.5 hours, permanent (part-time considered)**
**Band 8a, Salary: £39,239 - £47,088 per annum**

An exciting opportunity has arisen for an experienced Advanced Neonatal Nurse Practitioner to join the team in the state-of-the-art Neonatal Intensive Care Unit in the new Forth Valley Royal Hospital. The successful candidate should have a level 1 NMC registration, an accredited qualification as an Advanced Neonatal Nurse Practitioner, and recent experience of working as an ANNP within a Neonatal Intensive Care Unit

For further information and informal chat or visit please contact Lynette MacKenzie on 01324 567480.

The duties of this post require the successful candidate to be a member of the Protecting Vulnerable Groups (PVG) Scheme. More information on this scheme can be found at www.disclosurescotland.co.uk

**Application forms and job descriptions are available by visiting www.show.scot.nhs.uk Alternatively by quoting relevant post title and reference number and e-mailing FV-UHB.Recruitment@nhs.net or by telephoning the recruitment answerline on 01786 447488.**

**Closing date: Friday, 11th October 2013 at 12 noon.**

**Please quote reference number: 0713369.**

NHS Forth Valley is an equal opportunities employer.

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For further information,
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Fax: 01279 714519
Email: tricia@infantgrapevine.co.uk

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[1] Shah N. et al. *J Clin Anesth*. 2012 Aug;24(5):385-91. [2] Castillo A et al. Pediatric Academic Societies Annual Meeting. 2007. [3] Baquero H et al. *Acta Paediatrica*. 2011.
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# Peyona®

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Peyona caffeine citrate 20 mg/ml.
Solution for infusion and oral solution

Peyona®

caffeine citrate

## Treatment of primary apnoea of premature newborns

**Peyona® 20 mg/ml solution for infusion and oral solution** (caffeine citrate). Please refer to Summary of Product Characteristics (SmPC) before prescribing
**Prescribing Information. Presentation** Peyona® is a clear, colourless, aqueous solution at pH=4.7. Each 1 ml ampoule contains 20 mg of caffeine citrate (20 mg of caffeine citrate is equivalent to 10 mg caffeine). **Indications** Treatment of primary apnoea of premature newborns. **Dosage and Administration** The recommended dose regimen in previously untreated infants is a loading dose of 20 mg caffeine citrate per kg body weight administered by slow intravenous infusion over 30 minutes, **using a syringe infusion pump** or other metered infusion device. After an interval of 24 hrs, maintenance doses of 5 mg/kg body weight may be administered by slow intravenous infusion over 10 minutes every 24 hrs. Alternatively, maintenance doses of 5 mg/kg body weight may be administered by oral administration, such as through a nasogastric tube every 24 hrs. The dose expressed as caffeine base is one-half the dose when expressed as caffeine citrate (20 mg caffeine citrate are equivalent to 10 mg caffeine base). In preterm infants with insufficient clinical response to the recommended loading dose, a second loading dose of 10-20 mg/kg maximum may be given after 24 hrs. Higher maintenance doses of 10 mg/kg body weight could be considered in cases of insufficient response. Where clinically indicated, caffeine plasma levels should be monitored. The diagnosis of apnoea of prematurity may need to be reconsidered if patients do not respond adequately to a second loading dose or maintenance dose of 10 mg/kg/day. When given IV, caffeine citrate should be administered by controlled IV infusion. Caffeine citrate can be either used without dilution or diluted in sterile solutions for infusion such as glucose 50 mg/ml (5%), or sodium chloride 9 mg/ml (0.9%) or calcium gluconate 100 mg/ml (10%) immediately after withdrawal from the ampoule. Caffeine citrate can be administered by intravenous infusion and by the oral route. The product must not be administered by intramuscular, subcutaneous, intrathecal or intraperitoneal injection. *Duration of treatment:* The optimal duration of treatment has not been established. Treatment is usually continued until the infant has reached a post-menstrual age of 37 weeks, by which time apnoea of prematurity usually resolves spontaneously. Caffeine citrate administration should be stopped when the patient has 5-7 days without a significant apnoeic attack. If the patient has recurrent apnoea, caffeine citrate administration can be restarted with either a maintenance dose or a half loading dose, depending upon the time interval from stopping caffeine citrate to recurrence of apnoea. Because of the slow elimination of caffeine in this patient population, there is no requirement for dose tapering on cessation of treatment. As there is a risk for recurrence of apnoeas after cessation of caffeine citrate treatment monitoring of the patient should be continued for approximately one week. **Contraindications** Hypersensitivity to active substance or excipients. **Special Warnings and Precautions** Other causes of apnoea should be ruled out or properly treated prior to initiation of treatment with caffeine citrate (see SmPC for full details). Baseline plasma concentrations should be measured in neonates born to mothers who consumed large quantities of caffeine prior to delivery or newborns previously treated with theophylline. Extreme caution in newborns with seizure disorder. Caffeine has been shown to increase heart rate, left ventricular output, and stroke volume therefore caution should be exercised in newborns with known cardiovascular disease. Caution in newborns with impaired renal or hepatic function or suffering gastro-oesophageal reflux. Careful monitoring for development of necrotising enterocolitis. Caffeine citrate causes a generalised increase in metabolism, which may result in higher energy and nutrition requirements during therapy. The diuresis and electrolyte loss induced by caffeine citrate may necessitate correction of fluid and electrolyte disturbances. **Interactions** Inter-conversion between caffeine and theophylline occurs in preterm neonates; these active substances should not be used concurrently. Caffeine has the potential to interact with active substances that are substrates for CYP1A2, inhibit CYP1A2, or induce CYP1A2. However, caffeine metabolism in preterm neonates is limited due to their immature hepatic enzyme systems (see SmPC for full details). **Pregnancy and Lactation** Caffeine in animal studies, at high doses, was shown to be embryotoxic and teratogenic. These effects are not relevant with regard to short term administration in the preterm infant population. Caffeine is excreted into breast milk and readily crosses the placenta into the foetal circulation. Breast-feeding mothers of neonates treated with caffeine citrate should not ingest caffeine-containing foods, beverages or medicinal products containing caffeine (see SmPC for full details). **Undesirable effects** The known pharmacology and toxicology of caffeine and other methylxanthines predict the likely adverse reactions to caffeine citrate. Effects described include central nervous system (CNS) stimulation such as irritability, restlessness and jitteriness, and cardiac effects such as tachycardia, hypertension and increased stroke volume. These effects are dose related and may necessitate measurement of plasma levels and dose reduction. The adverse reactions described in short and long term published literature are: *Common*: infusion site phlebitis, infusion site inflammation; *Rare*: hypersensitivity reaction; *Not known*: sepsis, hypoglycaemia, hyperglycaemia, failure to thrive, feeding intolerance, irritability, jitteriness, restlessness, brain injury*, convulsion*, deafness* (*more frequent in placebo group), tachycardia, also associated with increased left ventricular output and increased stroke volume, regurgitation, increased gastric aspirate, necrotising enterocolitis (see SmPC for full details), urine output increased, urine sodium and calcium increased, haemoglobin decreased, thyroxine decreased. Caffeine may suppress erythropoietin synthesis and hence reduce haemoglobin concentration with prolonged treatment. Transient falls in thyroxine (**T4**) have been recorded in infants at the start of therapy but these are not sustained with maintained therapy. **Pharmaceutical Precautions** None. After opening the ampoule, the product should be used immediately. For storage conditions of the diluted medicinal product see SmPC. **Special precautions for disposal and other handling** Aseptic technique must be strictly observed throughout handling of the medicinal product since no preservative is present. For single use only. Discard any unused portion left in the ampoule. Do not save unused portions for later administration. No special requirements for disposal. **Legal category** POM. **Packs and Prices** Basic NHS price of £172.50 per pack of 10 x 1 ml ampoules. **Marketing Authorisation Number** EU/1/09/528/002. Full prescribing information is available from the **Marketing Authorisation Holder** Chiesi Limited, Cheadle Royal Business Park, Highfield, Cheadle, SK8 3GY. **Date of Preparation** April 2012.

**Adverse events should be reported. Reporting forms and information can be found at www.mhra.gov.uk/yellowcard. Adverse events should also be reported to Chiesi Limited. (address as above) Tel: 0161 488 5555**

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Date of preparation: June 2012 Code CHPEY20120643