Perinatal medicine and radiology joint session

G92 IS PRESSING ON THE ABDOMEN A METHOD OF DIAGNOSING HYPOVOLAEMIA IN THE NEONATAL INTENSIVE CARE UNIT?

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Aim: Assessment of detailed cardiovascular parameters in the newborn is difficult. Hypotension is commonly related to hypovolaemia and/or myocardial dysfunction. Historically it has been taught that blood pressure (BP) response to pressure over the right upper quadrant (RUQ) of the abdomen (over the liver) in hypotensive infants may help differentiate between the two. If BP rises significantly during this "test", hypovolaemia rather than myocardial dysfunction is the cause. In theory the liver contains reserves of circulating blood (~10 ml/kg) and the test leads to a temporary autotransfusion. This test is not validated.
Methods: Two newborn pigs (~1.5 kg) were anaesthetised and ventilated in accordance with Home Office guidelines. An umbilical artery catheter was inserted to measure BP. Each test consisted of measuring BP response to RUQ abdominal pressure performed for 5 s in order to depress the abdominal wall by 3 cm. Over 6 h 10 ml/kg aliquots of blood were removed up to 30 ml/kg and then sequentially replaced until normovolaemic. This was then followed by 10 ml/kg additions of 0.9% saline up to 30 ml/kg above normal circulating volume. The response to this test was determined twice at each of these points as well as during myocardial ischaemia (induced by reducing inspired oxygen to 8%).
Results: 40 "tests" were analysed. Median BP (mm Hg (interquartile)) results are shown in the table. There was a consistent significant rise in BP (~30%, $p<0.01$) during these tests. The BP rise was no different during hypovolaemia, hypervolaemia or hypoxia.
Conclusion: Pressing on the abdomen to assess cardiovascular status in the newborn is unhelpful. BP response to pressure over the liver does not provide information that can be used to determine overall circulating volume. Giving extra boluses of fluid purely in response to this test could be harmful.

G92 Table BP response to the test at different levels of circulating volume

	Baseline BP	BP during test	% Increase in BP
Normovolaemia	53 (4.5)	75 (12.5)	34 (15)
−10% blood volume	50 (4.5)	67 (3.5)	36 (10)
−20% blood volume	43 (9)	65 (14)	29 (11)
−30% blood volume	37 (8.5)	49.5 (9.5)	31 (4)
+10% blood volume	55 (8)	76.5 (7.5)	31 (20)
+20% blood volume	51 (6)	73 (6)	43 (5)
+30% blood volume	54 (4.25)	74 (8.25)	37 (16)
Hypoxia	55 (7.5)	75 (3.75)	31 (16)

BP, blood pressure.

G93 DO WE NEED A NEW WAY TO ASSESS HEART RATE DURING NEWBORN RESUSCITATION? RESULTS OF A RANDOMISED STUDY

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Background: Heart rate (HR) is a primary clinical indicator directing newborn resuscitation. The time taken to assess the HR by auscultation in relation to accuracy during newborn resuscitation is not known.
Objective: To assess the accuracy and time taken to assess HR by auscultation in simulated resuscitation scenarios.
Methods: The VitalSim manikin (Laerdal Medical, Stavanger, Norway) was used in a randomised, single blind study. Four HR settings (0, 40, 80, 120 beats per minute (bpm)) were randomly assigned and participants assessed them by auscultation in each of three different scenarios. The first scenario assessed actual HR at birth. Assessments within 5 bpm of set HR were accepted as accurate. In the second scenario HR was assessed during ventilation and assigned to standard ranges (<60, 60–100, >100 bpm). In the third scenario HR was assessed after three cycles of compressions and ventilation and assigned to standard ranges. The time was recorded by a digital recorder.
Results: In total 61 midwives, nurses and doctors participated in the study providing 183 assessments over three scenarios. The mean time to estimate HR for scenarios 1, 2 and 3 was 17.0, 9.8 and 7.8 s. Participants were faster at assigning ranges than an actual HR. HR assessments were inaccurate in 31% (scenario 1), 28% (scenarios 2) and 26% (scenario 3). Assessors who were accurate tended to be quicker and this was significant in scenario 2 ($p<0.02$). Inaccurate assessment would have changed management in 28% of all cases.
Conclusions: The overall error rate is high in this model with a set HR volume and no other confounding factors. In reality, assessment will probably be slower and less accurate. This study suggests that HR estimation by auscultation at birth will be wrong in at least 28% of cases, leading to incorrect management decisions. Either a new technique or better accuracy is needed.

G94 EPICURE 2: AIRWAY FUNCTION IN EXTREME PRETERM INFANTS AT 1 YEAR

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Introduction: The survival of infants born extremely preterm is associated with a high prevalence of bronchopulmonary dysplasia (BPD). Respiratory follow-up has been undertaken in a subset of babies in the EPICure 2 study, which recruited all survivors born at less than 27 weeks' gestational age in England during 2006.
Methods: Raised volume forced expiratory manoeuvres were performed in extremely preterm infants (EPI) and healthy term infants at ≈1 year (corrected) age. Results were expressed as Z-scores to adjust for age, sex and body size.[1]
Results: A total of 87 subjects was studied. The groups were well matched for sex and age. Z-scores for forced vital capacity (FVC), forced expiratory volume in 0.5 s ($FEV_{0.5}$) and forced expiratory flow in the mid range ($FEF_{25–75\%}$) were significantly lower in the EPI group (see table).

G94 Table Spirometry results at 1 year of age

	EPI n = 49	TC n = 38	95% CI of difference (EPI-TC)
Male, n (%)	49 (47%)	38 (42%)	−16% to 25%
Gestation, weeks	25.7 (1.0)	39.7 (1.1)	−14.5 to −13.5
Age at test, weeks	51.1 (8.1)	48.3 (9.0)	−0.9 to 6.5
FVC Z-score	−1.3 (1.3)	0.0 (1.3)	−1.8 to −0.7***
$FEF_{25–75\%}$ Z-score	−3.3 (1.8)	−1.5 (1.1)	−2.5 to −1.2***
$FEV_{0.5}$ Z-score	−2.6 (2.0)	−0.7 (1.4)	−2.6 to −1.2***

Results are expressed as mean (SD) unless stated.
***$p<0.001$.
EPI, extremely preterm infants; $FEF_{25–75\%}$, forced expiratory flow in the mid range; $FEV_{0.5}$, forced expiratory volume in 0.5 s; FVC, forced vital capacity; TC, healthy term controls.

Conclusions: Despite the suggestion that ''new BPD'' is primarily associated with alterations in alveolar development, a marked reduction in airway function persists throughout the first year of life in those born extremely preterm.

1. **Jones M,** *et al*. *Am J Respir Crit Care Med* 2000;**161**:353–9.

G95 OUTCOMES OF FETUSES WITH SEVERE RHESUS DISEASE FOLLOWING IN-UTERO TRANSFUSIONS: A 10-YEAR EXPERIENCE

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Background: In-utero transfusion (IUT) has transformed the fetal management and outcome of severe Rhesus disease.
Objective: To assess the outcomes of fetuses who had IUT in a tertiary fetal medicine centre over a 10-year period.
Methods: We retrospectively analysed the case notes of mothers and their babies who had IUT for severe Rhesus disease from 1 January 1997 to 31 December 2006. Babies receiving IUT were followed up to 1 year postnatal age.
Results: In the 10-year period, 263 IUT were performed in 80 pregnancies affected by severe Rhesus disease. The median number of IUT was three (range 1–8). The antibodies involved were anti-D (84%), anti-Kell (13%) and anti-c (3%). 19 (24%) cases were hydropic; of these, three were intrauterine deaths, two neonatal deaths and three were born elsewhere. There were 74 live births (92.5%) with a median gestation of 34 weeks (range 24–38 weeks, 11 babies $\leqslant$30 weeks); five infants were born elsewhere. Of the 69 infants born in our centre, three died in the early neonatal period and one infant at 19 months died from sudden infant death syndrome. The median cord haemoglobin was 10.7 g/dl (range 5.7–20.9). 29/69 babies (42%) required a total of 45 exchange transfusions (range 1–5). 53/69 babies (77%) required phototherapy (range 1–10 days). 57/69 babies (83%) required 151 top-up blood transfusions (median 2, range 1–20). Of those 30 weeks and less, 9/11 survived (82%), two had retinopathy of prematurity and three babies had cranial ultrasound abnormalities. At 2 years of age, 7/9 babies were normal and two had developmental delay. Of the babies surviving more than 30 weeks, 53/56 (95%) babies were followed up to 1 year of age and all had normal neurodevelopment except one with sensorineural deafness.
Conclusion: IUT is safe and does not appear to increase postnatal morbidity. In our experience, it has reduced the need for exchange transfusions in the postnatal management of babies with severe Rhesus disease. However, these babies are likely to need top-up transfusions.

G96 PRE-LABOUR CAESAREAN DELIVERY ALTERS CHOLESTEROL HANDLING IN PIGLETS 7 DAYS POSTPARTUM

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We have previously reported that Caesarean section (CS) delivered piglets accumulate less hepatic lipid after 7 days on total parenteral nutrition (TPN) than vaginally delivered (VD) animals. These sustained changes in lipid in animals fed the same diet implied changes in gene expression. We therefore analysed the differences in gene expression between CS and VD animals 7 days after birth and here report changes in gene expression and metabolite profile associated with cholesterol handling.
Method: Experiments were conducted under licence with relevant ethical approval. Piglets born by CS ($\approx$3 days preterm, n = 5) or VD (at term, n = 4) had bilateral jugular catheters inserted 3 h postpartum. The piglets were fed for 7 days intravenously before tissue sampling. Hepatic RNA was isolated and analysed using Affymetrix Porcine GeneChip arrays by the MRC CSC-IC Microarray Centre (Hammersmith Hospital). Liver cholesterol and cholesterol ester content was determined by densitometry following chromatographic separation. Plasma cholesterol was determined using a commercial kit.
Results: A number of genes associated with cholesterol metabolism and transport showed significant differences between CS and VD piglets, including Apo-A1, StAR-related lipid transfer protein (START) and acyltransferase ACAT2. Furthermore, quantitative reverse transcription PCR measurement of cytosolic 3-hydroxy-3-methylglutaryl coenzyme A synthase (a key enzyme in cholesterol synthesis) expression showed it was increased in the VD piglets (CS 9.18 $\pm$ 3.30; VD 45.87 $\pm$ 8.34, $p<0.05$) in agreement with elevated plasma cholesterol in the VD versus CS piglets (CS 1.04 $\pm$ 0.25; VD 1.73 $\pm$ 0.32 mmol/l, $p<0.05$). Furthermore, although there was no difference in the liver content of cholesterol between CS and VD piglets (CS 1.05 $\pm$ 0.17; VD 1.35 $\pm$ 0.19 mg/g, $p = 0.233$) there was a significant difference in the hepatic content of cholesterol esters (CS 1.81 $\pm$ 0.22; VD 0.75 $\pm$ 0.79 mg/g, $p<0.003$).
Conclusion: These data suggest that the mode of delivery significantly alters cholesterol metabolism and handling 7 days postpartum. The long-term health implications of these differences are unknown.

G97 THE CHANGING PROFILE OF NEONATAL CARE: EPICURE 2 (2005) VERSUS UK NEONATAL STAFFING STUDY (1996)

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Background: In 1996 the UK Neonatal Staffing Study (UKNNSS) carried out a census of neonatal unit activity in the UK to determine whether implementation of the British Association of Perinatal Medicine standards would improve outcomes from neonatal care. This census was repeated for England in 2005 as part of the EPICure 2 study.
Aim: To determine how the capacity and activity levels of neonatal services in England have changed since 1996 and how they vary between unit types.
Methods: A unit profile questionnaire (adapted from UKNNSS) was mailed to all 182 English neonatal units in the summer of 1996 to collect information about unit activity, cot capacity and staffing levels in 2005. The forms were completed by the paediatric EPICure2 coordinator on each unit with inputs from neonatal nursing, obstetric and midwifery staff. Data from 2005 were then compared with the UKNNSS data from 1996.
Results: The total number of units providing sustained neonatal intensive care in England reduced from 145 in 1996 to 136 in 2005. Over this period cot provision remained fairly stable, although there were significant increases in low birth weight admissions, babies requiring ventilation/continuous positive airway pressure (CPAP) and days of ventilation/CPAP. Low levels of neonatal intensive care provision were recorded in level 1 neonatal units (see table).

G97 Table Comparison of cot establishment and activity levels in NICU: 1996 vs 2005

Establishment and activity variables	UKNNSS: 1996 Median (IQR)	EPICure2: 2005 Median (IQR)	Wilcoxon p Value
Admissions to NICU	323 (270–417)	343 (261–467)	0.438
Total cots in NICU	18 (14–22)	19.5 (15–24)	0.193
Intensive care cots	4 (2–6)	4 (2–6)	0.861
Babies ventilated/CPAP	66 (42–110)	100 (62.5–168)	<0.0001
Days ventilated/CPAP	450 (211–1006)	903 (423–1624)	<0.0001
Admissions <1500 g	44 (32–74)	56 (38–87)	0.022

CPAP, continuous positive airway pressure; NICU, neonatal intensive care unit; UKNNSS, UK Neonatal Staffing Study.

Conclusions: Increases in activity levels in neonatal intensive care over time have not been matched by a proportionate increase in cot provision.

G98 SURVIVAL AT LESS THAN 24 WEEKS' GESTATION: THE HIDDEN MORBIDITY OF NON-SURVIVORS

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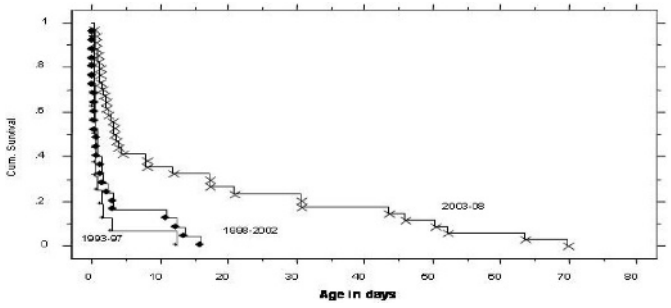
Aims: To describe the length of survival and interventions received in babies at less than 24 weeks who were actively treated but did not survive and document any changes in the past 15 years.
Methods: We used a well-validated population-based database (Perinatal Mortality Survey) to identify deaths among live-born infants born at 22 or 23 weeks' completed gestation between 1993 and 2008. We identified survivors from the regional database supplied from the tertiary neonatal units in this region. Three epochs were defined: 1993–7, 1998–2002 and 2003–8 and Kaplan–Meier survival curves were plotted. Detailed analysis of the last cohort was used to describe morbidity and interventions received.
Results: During the study period there were 472 132 total live births, of whom 231 were live born at 22 or 23 weeks but subsequently died. During the entire study period overall survival rates to discharge were less than 10%. Seventy-nine non-survivors lived for at least 6 h, and of these the median age at death was 12 h (n = 17, 1993–7), 21 h (n = 26, 1998–2002) and 3.7 days (n = 36, 2003–8). For ease of presentation the presented analysis is truncated at 80 days of age (see fig). In live-born non-survivors between 2003 and 2008, 56/92 were actively resuscitated, 36 survived at least 6 h, four received a laparotomy, one received patent ductus arteriosus ligation and one received laser treatment for retinopathy of prematurity. The survival rate during this period remained the same.
Conclusions: Small increases in survival rates are associated with a large increase in the number of days non-survivors receive active intervention.



G98 Figure

G99 A NEW UK–WHO GROWTH CHART FOR PRETERM INFANTS

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Background and Aims: New UK growth charts based on the new World Health Organization (WHO) growth standard will be introduced in Spring 2009. They depict the optimal growth of healthy infants and will be used for clinical monitoring of well infants born after 32 weeks' gestation. This has precipitated the need to develop a corresponding chart on which to plot the growth of very preterm infants.
Method: A working group was formed combining chart design and neonatal expertise. A specification was developed and a prototype chart developed using WHO data from 2 weeks to 4 years with re-analysed UK 1990 birthweight data for 23–42 weeks' gestation. This was tested by nine expert neonatologists who plotted sample data and provided feedback on ease of use.
Design: The new chart has three sections. The first shows UK reference data for birth size at 23–42 weeks' gestation. Two further sections then describe growth from 2 weeks to 6 months and 6–24 months corrected age, showing the WHO growth standards in familiar nine centile format. The instructions emphasise the difference between these cross-sectional and longitudinal charts. The space within the centile curves has been maximised to ease plotting and interpretation of growth over periods of short-term illness. The measurement scale has been extended down to −5 SD to facilitate interpretation of data for severely growth-restricted infants as well as term infants with major pathology.
Results: The consultation demonstrated a wide range of approaches to the calculation and use of corrected gestational age. The sample plotting proved difficult, with 28% (20) of 71 plotted ages incorrect, 11% (8) by more than 1 week and one by 13 weeks. As a result the age axis of the chart has been modified to allow the recording of key dates, which avoids the need to calculate corrected age.
Conclusions: The design cycle has already improved the usability of the chart. The chart will undergo further testing and refinement by expert groups for a nationwide launch in May 2009.

G100 VARIATIONS IN DIAGNOSTIC IMAGE QUALITY WITH MECHANICAL INDEX VALUES IN NEONATAL CARDIAC COLOUR FLOW DOPPLER ULTRASOUND SCANNING

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Aim: The British Medical Ultrasound Society (BMUS) recommends that for neonatal scanning involving exposure to lung, the scan time should be limited if the mechanical index (MI) is greater than 0.3 during the scan. The BMUS also states that there is a theoretical risk of cavitations for MI greater than 0.7 and this risk increases as MI increases. A recently published paper reporting on MI values used in neonatal cardiac scanning suggests that typically MI values may be four to six times higher than those recommended by the BMUS. In our neonatal unit the default MI value for paediatric echocardiograms was 1.6. The aim of our study was to investigate the effect of different MI values on the diagnostic quality of colour flow Doppler images.
Methods: A prospective study was carried out in one of the regional tertiary neonatal intensive care units. 12 sets of power clips were recorded using four different MI values: 0.3, 0.7, 1.1 and 1.3–1.6. During recording these clips no other parameters were changed. Diagnostic image quality was assessed by two different assessors and classified into three groups: very good/good, acceptable and poor quality. Well informed consent was taken from parents and the MI value was not increased from that used routinely in any case.
Results: Diagnostic image quality was consistently good while using MI values between 1.1 and 1.6. When using MI value of 0.7, 75% (9/12) of cases had good or acceptable quality whereas 25% (3/12) had poor quality. 75% (9/12) of cases had poor quality and 25% (3/12) had good or acceptable diagnostic quality while using a MI of 0.3.
Conclusion: Diagnostic image quality was poor in a significant number of cases (75%) while using an MI value of 0.3, as recommended by the BMUS. However, using MI values between 0.7 and 1.1, image quality improved significantly. We recommend further studies to investigate how good diagnostic image quality can be maintained while keeping MI values low so as to minimise any risks associated with the exposure of neonatal lung to ultrasound.