Guidelines for the Investigation of Newborn Infants who suffer a Sudden and Unexpected Postnatal Collapse In the First Week of Life

Recommendations from a Professional Group on Sudden Unexpected Postnatal Collapse

July 2010
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Guidelines for the investigation of newborn infants who suffer a sudden and unexpected collapse after birth in the first week of life

Introduction

This document is intended to provide guidance for the appropriate investigation of infants who suffer a sudden and unexpected collapse after birth in the first week of life. The guideline covers investigation of both survivors and those who die. It takes account of published guidance for the investigation of Sudden Unexpected Death in Infancy (SUDI)(1) and input from UK perinatal professionals.

Definition

For the purpose of these guidelines, an infant who suffers a ‘Sudden Unexpected Postnatal Collapse’ includes any term or near term (>35 weeks gestation) infant who

- is well at birth (normal 5 minute Apgar score and deemed well enough to have routine postnatal care) and,
- collapses unexpectedly requiring resuscitation with intermittent positive pressure ventilation within the first seven days of life and,
- who either dies or goes on to require intensive care or develops an encephalopathy

Purpose of guidelines

Sudden unexpected postnatal collapse (SUPC) in the hours and days after birth affects around (2 to be confirmed but around 45) infants a year within the United Kingdom. There is significant mortality and long-term neuromorbidity associated with such collapse. The approach to investigation is currently highly disparate, the range of underlying aetiologies not well elucidated and the potential for treatment or genetic counselling limited.

Underlying congenital anomalies and conditions arising through pregnancy and birth are over-represented in this group of infants compared to older infants who suffer sudden unexpected death (2). The proximity to birth and extra-uterine adaptation necessitates a thorough examination of perinatal and situational factors. Although the published guidance for the investigation of Sudden Unexpected Death in Infancy should encompass all infant deaths, the emphasis is on those dying outside hospital after the first month of life, where parental lifestyle factors and non-accidental injury may have more contribution. In SUDI cases which occur outside a hospital there is rarely the opportunity to carry out investigations prior to death. For babies who collapse in hospital and who subsequently die, there is often the opportunity to carry out investigations during the period of intensive care. In addition the SUDI guidance does not include investigation of survivors who account for around 50% of those infants suffering SUPC.

This document is not intended to replace or duplicate the guidance for the investigation of Sudden Unexpected Death in Infancy (SUDI) (1) but aims to improve the likelihood of diagnosis in this group of newborn infants. This guideline does not supersede the national arrangements for a joint agency ‘rapid response’ to unexpected deaths in infancy and childhood (3) or for local risk management review for survivors.

The guideline intends to standardise the investigative approach to this group of infants in order to

1. establish the most likely cause of collapse
2. document any underlying disease whether or not considered a direct cause for collapse
3. provide information relevant to the future reproductive health of parents and the future health of siblings of the case infant.
4. collect and secure evidence where required by the Coroner/Procurator Fiscal (PF)
5. clarify prognosis and ongoing management in those who survive

It does not intend to address professional responsibilities or recommend an approach to management of such infants; instead the emphasis is the optimisation of the investigatory process. Consideration of transfer for specialist management including cooling treatment should be addressed by local network guidelines.

Background
Sudden unexpected postnatal collapse, as defined above, in apparently well term babies in the first week of life is a rare event. Although infrequent in any one centre these infants are well described in the literature and commonly suffer death or severe long-term neurological sequelae (4)(5)(6)(7). A study conducted through the British Paediatric Surveillance Unit in 2009 estimated the UK incidence of SUPC in the first 12 hours as (?)/1000 live births of whom (?)% died. There is a highly disparate approach to investigation of these infants.

In order to protect parents from the perceived ordeal of post mortem clinicians may attribute death to the hypoxic-ischaemic sequelae without elucidating the cause of the initial collapse. In those infants where careful perinatal post mortem has been undertaken, valuable information has often been found. Underlying conditions such as antenatal brain injury, infection, metabolic defects, congenital central hypoventilation syndrome, congenital adrenal hypoplasia and cardiac abnormalities such as myopathies, infarctions and conduction abnormalities have all been described (2)(8). Indeed, in those infants dying unexpectedly within the first week of life, almost 60% are explained following post mortem (2) compared to later SUDI deaths where a new but preceding diagnosis is confirmed in 37% of cases (9). When babies die, such pathologies have important implications for the parents not only in explaining their child’s catastrophic deterioration but also in aiding the grieving process and providing information for future pregnancies (10). In those infants who survive, a detailed set of investigations will optimise the chance of finding an explanation for the collapse which will have implications for management and prognosis of the infant.

Concern about this group of infants was raised in 2008 and UK neonatologists sought to study the incidence of SUPC through the British Paediatric Surveillance Study. This was preceded by an informal survey of members of the British Association of Perinatal Medicine, which showed that many neonatologists had experience of such infants although they were rare in any one centre. There was concern that the typical experience of the majority was unexpected and unpredictable deterioration in an apparently well infant with no apparent cause being found using standard investigations. Many reported a poor uptake of post mortem examination and there was inconsistency of referral to the Coroner/PF despite fulfilling the criteria for Sudden Unexpected Death in Infancy.

Infants suffering SUPC in the first week of life ought to undergo the process recommended by the Kennedy protocol, but there is a very strong case for additional data and investigations for those dying in the immediate postnatal period. In addition published literature suggests that around 50% of babies survive following SUPC and these would not be covered by the Kennedy protocol.

At the end of December 2008 a group of perinatal professionals was assembled to seek consensus on guidelines for investigation of such infants. This group comprised neonatologists, biochemists, pathologists, radiologists and experts in SUDI, and included representation from obstetrics, midwifery and bereavement groups (Appendix 3).

A set of investigations has been agreed which the group believe will determine, as far as possible, the causes of SUPC in both those dying and in survivors. There is a strong recommendation for early
involvement of the Coroner/PF and for the post mortem examination to be performed by a paediatric/perinatal pathologist. In addition, the group recommend retention of brain for optimal neuropathology as well as seeking consent for retention of tissue for recognised and unrecognised future purposes. A minimum dataset to aid clinicians in their investigation of such cases is included. The guidelines focus on an investigatory approach and do not extend to recommendations about process or case review following such events. It is expected that local procedures in investigating serious adverse events will take place and reference to the Multi-agency Protocol for Care and Investigation of Sudden Unexpected Death in Infancy is recommended (3).
Funding

The charity WellChild has funded this initiative to develop these recommendations following their funding of the British Paediatric Surveillance Study of the Incidence of Sudden Unexpected Postnatal Collapse.

www.wellchild.org.uk

WellChild
16 Royal Crescent
Cheltenham
Gloucestershire GL50 3DA
Protocol

1. Collapse outside hospital
These cases should be investigated as per the guidance for the investigation of Sudden Unexpected Death in Infancy (1) and as per any local procedures. The following additional investigations are recommended in this early neonatal group due to the temporal proximity to birth as well as the contribution of congenital anomalies or infection to aetiology. The investigations should also be carried out for survivors.

2. Information to be collected by medical staff following presentation (Appendix 1 for recommended data fields)
   1. Parental medical history
   2. Full parental drug, alcohol and nicotine history
   3. Three generation family tree (noting where available egg donation, sperm donation)
   4. Obstetric history including information about infection, fetal growth, suspected fetal anomalies, fetal movements and liquor volume- recommended that this history be taken from an consultant obstetrician or senior trainee
   5. Labour and birth including maternal medication and markers of fetal wellbeing (scalp pHs, cord pHs, CTG, passage of meconium, requirement for resuscitation)-recommended that this history be taken from an consultant obstetrician or senior trainee
   6. Health of infant until collapse including growth and feeding
   7. Circumstances surrounding collapse, incl who was present, was baby feeding, position of baby (detailed history obtained from staff who were present at the time of collapse and family. It is also important to collect information from other agencies who may have been involved with the family such as primary care, social care and police).
   8. Full resuscitation details
   9. Full examination

3. Investigations to be performed whilst infant is alive
Liaison with local and regional laboratories is mandatory to ensure optimal collection and timing of samples. Transfer to a specialist unit for imaging should be considered if the baby is sufficiently stable.
   1. Placenta- where available, both fixed and fresh samples of placenta and cord should be sent as soon as possible after birth for pathology and microbiology.
   2. Maternal blood: Kleihauer, viral titres (serum to be frozen for acute phase titres), toxicology
   3. Maternal high and low vaginal swabs
   4. Neonatal blood: FBC, coagulation, renal and liver biochemistry, glucose, lactate, calcium, magnesium, ammonia, beta-hydroxybutyrate, amino acids, free fatty acids, acyl carnitine profile, cortisol (3 samples at different time points) culture, viral titres, DNA and chromosomes, retained blood spot.
      If there is any suspicion that the collapse or death may have been as a consequence of unrecognised hypoventilation / apnoea, then a sample of DNA should be sent specifically to look for abnormalities of the PHOX2B gene which is commonly implicated in congenital central hypoventilation syndrome.
   5. CSF: biochemistry, glucose (paired with plasma glucose), culture, virology, lactate, glycine, storage
   6. Surface swabs: bacteriology
   7. Urine: bacteriology, virology, toxicology, organic acids, amino acids, initial urine to be retained
   8. Imaging: skeletal survey (Appendix 2) cranial USS day 1, MRI brain (initial and in second week, see Appendix 3 for recommended sequences), renal/adrenal USS, ECG (at presentation and after 3 weeks of age), echocardiogram
9. Ophthalmoscopy/ Retcam
10. Skin biopsy for fibroblast culture
11. Muscle biopsy if unable to exclude neuromuscular or mitochondrial disorder
12. Electroencephalogram

4. Investigations performed after death where death has occurred on hospital premises

a) Before post mortem
It is recommended that if it has not been possible to take samples during life then, where feasible, certain samples should be taken immediately following death whilst awaiting post mortem. This would prevent significant degradation of material which will occur after death such that important diagnostic information will be lost.

The taking of post mortem samples requires to be performed on licensed premises (Human Tissue Act 2004) requiring the infant to be taken to the pathology department or where the local Pathology Licence permits, on the neonatal unit. Each area must establish a local agreement with their Coroner regarding the taking of such samples. Consent should be sought from parents (or Coroner/PF if the case has been referred to Coroner/PF) and documented using the appropriate sections of the standard neonatal post mortem consent form following full explanation of what samples are required and why there is a need.

The baseline samples should where possible be discussed with pathologist and biochemists. Those usually recommended are:
- Throat and nose swabs for bacterial and viral culture
- Blood culture
- CSF obtained by lumbar puncture or ventricular tap
- Blood, urine or vitreous for metabolic studies
- Skin biopsy
- Muscle biopsy

b) Post mortem
Every unexpected death must be reported to the Coroner/PF.

Every death resulting from an unexpected collapse where the cause is not known must be notified to the Coroner/Procurator Fiscal. In this situation, the doctor caring for the infant must not issue a certificate of the cause of death, even where that death may be secondary to the hypoxic-ischaemic consequences of the collapse.

It is important to recognise the additional distress that referral to a Coroner/PF may cause parents and to communicate this sensitively with them, emphasising the routine nature of this process with an explanation as to why the referral is being made (11). It is important that parents do not feel they are under suspicion for their child’s death and instead answers are being sought which may influence future decision-making. Most parents will want to know as much as possible about why their baby died but some find the idea of a post mortem difficult to contemplate even when they acknowledge the potential benefits.

- Where the Coroner/Procurator Fiscal orders a post mortem the Coroner/Procurator Fiscal should be urged to have a perinatal or paediatric pathologist perform the examination (1, 3).
• Where there is clinical suspicion of the cause of collapse and the Coroner/Procurator Fiscal does not order a post mortem, it remains crucial that the clinical cause of death is confirmed by a post mortem examination. It is highly recommended that such consent is obtained by a consultant paediatrician.

It is highly recommended that the post mortem is carried out by a perinatal or paediatric pathologist and that brain pathology is conducted and interpreted by a neuropathologist with appropriate perinatal expertise. The post mortem examination should be carried out within 48 hours of the infant’s death whenever possible. It is essential that all relevant information is available to the pathologist at the time of post mortem to inform the examination. This will include details of the mother, her pregnancy and labour as well as those of the infant, his birth, the events surrounding his collapse and his care until death. It is recommended that pathologists undertaking such examinations liaise with their local radiology and laboratory colleagues with respect to the range of ancillary investigations as there may be some variation in local practice.

Whole organs, other than the brain, will not be routinely retained unless recommended by the pathologist. However, consent should be sought for retention of the brain, and for any other samples or organs which may be useful in refining the diagnosis or in furthering present or future research into the causes of sudden death in neonates. If consent for whole brain retention is withheld, the brain may be fixed for 1-3 days before comprehensive sampling of key brain areas, as given below, with retention also of frozen samples as below. Residual tissue, constituting the bulk of the brain, can then be replaced in the infant’s body before release for the funeral. It is recommended that as in standard post mortem procedures, consent be sought for use of residual material in tissue blocks and frozen samples for potential future research purposes. Although requesting such consent may be regarded as too sensitive an issue at the time of death, various groups have achieved parental consent rates approaching 100% in such situations (12)(13).

Specific consent will also be required for genetic testing.

If despite all efforts both the Coroner/Procurator Fiscal and parents decline post mortem pathological examination, consideration should be given to requesting a post mortem MRI.

**Procedure**

1. **Photographs** - full frontal, face, profile, any dysmorphic features
2. **Radiology** - full radiological skeletal survey (Appendix 2), reported by a radiologist with paediatric training and experience
3. **Anthropometric measurements** - body weight, crown-rump, crown-heel, heel-toe and occipitofrontal circumference
4. **Microbiology** - to be taken as early as possible during the autopsy procedure and with stringent efforts to avoid contamination.
   a. **Bacteriology**
      i. Blood culture
      ii. Lung tissue/fluid
      iii. Bronchial swab
      iv. Cerebrospinal fluid
      v. Spleen
      vi. Any apparent site of infection
   b. **Virology (PCR and culture)**
      i. Postnasal swabs
      ii. Cerebrospinal fluid
iii. Lung tissue
iv. Heart muscle
v. Small intestine
vi. Blood

5. Organ systems- full dissection with weights
Minimum samples to be taken:
Thymus
Thyroid
Larynx
Trachea
Lung (two blocks from each of the lung lobes)
Heart (paraffin blocks to include parts of both ventricles, a major coronary artery and conducting system: sinoatrial node at the superior cavo-atrial junction, the AV node, the bundle of His and bundle branches)
Distal oesophagus
Diaphragm
Stomach
Small intestine
Colon
Mesenteric and subcarinal lymph nodes
Liver (right and left lobe)
Pancreas
Spleen
Right and left adrenal glands
Right and left kidneys
Gonad
Left fifth rib (to include costochondral junction and attached intercostals muscles)

In addition any lesion, injury or congenital abnormality should be sampled independently.

6. Frozen sections- staining with Oil Red O for fat
Liver
Heart
Kidney
Right and left lung
Skeletal muscle

7. Biochemistry
blood- glucose, urea, sodium, toxicology for maternal illicit drug use, blood spot for acyl carnitine profile
CSF- sodium, urea, glucose
vitreous fluid- sodium, urea, glucose, osmolality
urine- toxicology, amino and organic acids
bile- bile spot for acyl carnitine profile

8. Molecular/ cytogenetic investigations
skin- culture medium
spleen- frozen
thymus- frozen
liver- frozen
9. Retention of material for recognised and unrecognised future purposes

10. Central nervous system examination

It is recommended that a post mortem MRI of the brain be performed prior to opening the cranium (Appendix 2).

Detailed examination of the central nervous system is crucial and requires optimal fixation of the brain as well as retention of frozen samples (see (d) below). The principles of neuropathological examination require a period of fixation of up to three weeks for optimal studies. Shorter fixation periods may be used where early release of body and its organs for funeral is required.

   a) The fixed brain should be sliced in the coronal plane at 1cm intervals.
   b) All brain slices should be photographed to provide a permanent record of macroscopic appearances.
   c) Block selection

Cerebrum:
   • Representative sections of frontal, parietal and occipital lobes.
   • Hippocampus including inferior temporal lobe (bilateral)
   • Thalamus (bilateral)
   • Basal ganglia at the level of the mamillary bodies (bilateral). Many of these blocks can be obtained from a coronal section of the cerebral hemisphere taken through the mamillary bodies

Cerebellum:
   • Each hemisphere including dentate nucleus
   • Vermis

Brainstem:
   • Midbrain, pons and medulla (all levels of the brainstem if possible)

Spinal cord:
   Cervical, thoracic, lumbar and sacral cord if an abnormality is suspected.

d) Frozen samples of brain: 1cm³ sample of frontal and temporal lobes, cerebellum and brain stem.

5. Reporting

Reports should be made available as quickly as possible without compromising quality. A provisional report recording macroscopic appearances and all investigations initiated should be made within one week of autopsy to the Coroner/Procurator Fiscal who should thereafter report findings to the clinician. From the date of autopsy to issuing a final report should normally take no longer than two months.

The Coroner/Procurator Fiscal (where this is a Coroner/Procurator Fiscal case) or the lead paediatrician (where not a Coroner/Procurator Fiscal case) must meet with the parents at the earliest opportunity to explain the findings of all investigations.

The approach to reporting such infants will be governed by national reporting classification systems but the following is proposed

1. if there is a definite diagnosis then this should be given as the cause of death on the death certificate
2. in all other cases a ‘holding’ diagnosis should be given eg ‘unexplained pending further examination’
3. a final cause of death i.e. a specific diagnosis or ‘sudden unexpected neonatal death’ should be submitted after all investigations are completed.
6. Final case review meeting (14)

As for all unexpected deaths in childhood the final event in the investigative process should be a detailed local case review meeting, involving all professionals who have been involved in the care of the infant and mother, as well as the pathologist and any relevant professionals from other agencies (3). The purpose of this meeting is to share all available information and to reach a consensus on the “cause” of death if possible as well as identifying any contributory or notable factors that did not directly affect the processes leading to death but may be of clinical, social or genetic relevance. As for all unexpected deaths in childhood, understanding and attributing significance to such factors and reaching a conclusion on the likely cause of death or factors contributing to the death requires effective multiprofessional discussion and information sharing. The outcome of such a discussion meeting will be of great value both to those informing the family and to the conduct of a subsequent Crown investigation if held.
References


15. Standards for skeletal survey in suspected non accidental injury (NAI) in children
   http://www.bspr.org.uk/nai.htm
Appendix 1

Datasheet for investigation of newborn infants who suffer a sudden and unexpected collapse at or after birth

Name of person completing form ........................................................................................................................................
Grade ................................................................................................................................................................................
Contact details ......................................................................................................................................................................
Date form completed ..........................................................................................................................................................

History obtained from
1. ..........................................................................................................................................................................
2. ..........................................................................................................................................................................
3. ..........................................................................................................................................................................

A. Parental details

Ensure history from mother or from maternity records matches that held by primary care

1. Maternal details

Name .............................................................................................................................................................................
Date of birth .................................................................................................................................................................
Hospital number ............................................................................................................................................................
Current marital status: Married/single unsupported/ single supported (circle)
Occupation .................................................................................................................................................................
Country of birth ...........................................................................................................................................................
Ethnic group .................................................................................................................................................................
Pre-pregnancy conditions or illnesses ........................................................................................................................
Number of previous miscarriages .............................................................................................................................
Number of previous terminations .............................................................................................................................
Number of previous stillbirths .....................................................................................................................................
Number of previous live births ....................................................................................................................................
Any previous infant deaths? .........................................................................................................................................
Any relevant history in siblings ...................................................................................................................................
..................................................................................................................................................................................
Tobacco
How many cigarettes a day before pregnancy
How many cigarettes a day during pregnancy
Was the mother a smoker at the date of birth?
Was there any recent tobacco use in the twenty-four hours prior to collapse?

Alcohol
How many units a week during pregnancy?
How many units in the 24 hours before the baby’s collapse?

Illegal substances
Which drugs?
How many times during pregnancy?
Was there recent drug abuse in the twenty-four hours prior to collapse?
If yes, which drug, and when taken in relation to collapse?

2. Paternal details
It is important to enquire sensitively whether the putative father is the biological father
Father’s name
Father’s date of birth
Occupation
Country of birth
Ethnic group

Tobacco
How many cigarettes a day
Was there any recent tobacco use in the four hours prior to collapse?

Alcohol
How many units a week?
How many units in the 24 hours before the baby’s collapse?

Illegal substances
Which drugs?
How often?
Was there recent drug abuse in the twenty-four hours prior to collapse? ........................................
If yes, which drug, and when taken in relation to collapse ............................................................... 
Medical conditions or illnesses..............................................................................................................

3. Family history of both parents

(eg consanguinity, previous neonatal deaths/ genetic conditions)
................................................................................................................................................................
................................................................................................................................................................

Three generation family tree (inclusive of assisted reproductive techniques):
B. Pregnancy

Last menstrual period .................................................................

Expected date of birth ..............................................................

Gestational age when first booked ..............................................

Was this a twin pregnancy at any stage? ......................................

Was there any concern during pregnancy regarding fetal growth? ...........

  a. Was the growth thought to be poor? ........................................
  b. Was the growth thought to be excessive? ..................................
  c. Is there information about Doppler, liquor volume, biophysical profile? ...

Was there any fetal anomaly queried on a scan at any stage? .................

Concern or illnesses during pregnancy (including loss of fetal movement) . . .

Medications taken during pregnancy (prescribed or over the counter) ........

Did the mother fall or have any accident during this pregnancy? ............

Were both parents well at the time of birth and at the time of infant collapse? ....
C. Labour, delivery and birth

Onset of labour: induced/spontaneous/no labour

If not spontaneous please give reason for delivery

Was there spontaneous rupture of the membranes?

How long had membranes ruptured before birth? (hours)

Mode of birth: SVD/ breech vaginal/ forceps/ Ventouse/ elective CS/ emergency CS

If not SVD, please give reason for mode of birth

Were there concerns about the status of the fetus prior to birth?

a) Fetal heart rate

b) Fetal movements

c) Liquor volumes

d) Meconium staining of liquor

e) Maternal infection

f) Vaginal bleeding

g) Scalp pH

Lowest fetal scalp pH Base excess

Cord arterial pH Base excess

Cord venous pH Base excess

Placental weight

Estimated maternal blood loss (ml)

Other notes:.................................................................
D. Infant details

Infant's name

Hospital number

Date and time of birth

Gender

Gestation (weeks)

Birthweight (g)

Head circumference (cm)

Order of birth if multiple

Apgar scores at birth

Time to spontaneous respirations (mins)

Grade of most experienced person at resuscitation at birth

What resuscitation was required at birth?
### E. Circumstances of collapse

Date of collapse: ........................................... Time of day (24 hr clock) ...........................................

Time baby was last seen or heard to be well (or alive)? (24 hr clock) ..................................................

Description of baby at that time: ..............................................................................................................

In which ward was baby found collapsed? ............................................................................................

What health professionals had been involved in the baby’s care at any time prior to collapse? ..........

Who was in the room at the time of collapse? .........................................................................................

Who was responsible for supervision of baby just prior to collapse? .....................................................

Who identified the baby’s poor condition? ...............................................................................................

With whom was baby when found collapsed? .........................................................................................

What was the baby wearing at time of collapse? ......................................................................................

What was the baby’s bedding at time of collapse? ....................................................................................

<table>
<thead>
<tr>
<th>Location</th>
<th>Position of baby when identified</th>
<th>Prone</th>
<th>Supine</th>
<th>On right side</th>
<th>On left side</th>
</tr>
</thead>
<tbody>
<tr>
<td>In carer’s arms</td>
<td></td>
<td>Prone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On carer’s chest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>On carer’s abdomen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At breast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In mother’s bed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In own cot</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Feeding at time of collapse:

If not feeding 1. baby had not fed since birth

2. breast fed ...........h ........mins pre-collapse

3. bottle fed ...........h ........mins pre-collapse

If baby was feeding at time of collapse, was it at breast, by bottle, cup, syringe or nasogastric tube?

<table>
<thead>
<tr>
<th>What types of milk had the baby received since birth?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

Had there been any concerns about feeding prior to collapse? ...........................................................

Was the mother receiving or had she received in the previous 8 hours any analgesia (including epidural/spinal anaesthesia) or sedation?
Sudden Unexpected Postnatal Collapse

If yes, please provide detail........................................................................................................

Was the mother undergoing any procedures at the time of collapse eg episiotomy, epidural top up?
If yes, please provide detail........................................................................................................

What was the mother’s level of arousal at time of collapse (eg asleep, sedated, exhausted)?........

Had the baby received any medications/immunisations since birth?........................................

Had there been any concerns about the baby prior to collapse (eg breathing, colour, cry, vigour)?

Had any birth defects been identified prior to collapse?..............................................................

Had any of the following been a problem prior to collapse?
   a) Jaundice ...........................................................................................................................
   b) Infection............................................................................................................................
   c) Hypoglycaemia................................................................................................................
   d) Polycythaemia.................................................................................................................
   e) Poor feeding....................................................................................................................
   f) Other..............................................................................................................................

Condition when first found collapsed: Respirations..........breaths/min
                                       Heart rate.............bpm
                                       Colour...........................
                                       Tone..............................

Resuscitation details following collapse:
(Including time to heart rate> 100, time to first respirations, IPPV/ intubation/ cardiac massage/
resuscitation drugs, injuries observed, oronasal haemorrhage)

Names and grades of all present at resuscitation? .................................................................

Resuscitation successful? Yes, transferred to NNU at time: ....................................................
No, baby died before or at resuscitation

**F. Following collapse**

First blood gas after resuscitation: Arterial/venous/capillary

Date: ............................................. Time..........................................................

pH or H+ .............................................

pCO2 ............................................... 

BE or bicarbonate..................................

Lactate.............................................

First weight of baby and date after collapse.................................................................

First head circumference and date after collapse ...........................................................

Details of full examination (including diagrams where necessary):
Appendix 2

Standards for skeletal survey in suspected non accidental injury (NAI) in children

A single film (‘baby gram’) should be avoided as it gives an unsatisfactory exposure and combined views of chest abdomen pelvis and limbs should also be avoided, as limb detail is poor, with oblique projections of most joints.

Skull (SXRs)
AP and lateral, plus Towne’s view for occipital injury.
SXRs should be taken with a skeletal survey even if a CT scan has been performed.

Body
AP/frontal chest (including clavicles)
Oblique views of the ribs (left and right)
AP Abdomen with pelvis and hips

Spine
Lateral spine - cervical and thoracolumbar

Limbs
AP humeri, AP forearms
AP femurs, AP tibiae/fibulae
PA hands and DP feet

Supplemented by:
- Lateral views of any suspected shaft fracture.
- Lateral coned views of the elbows/wrists/knees/ankles may demonstrate metaphyseal injuries in greater detail than AP views of the limbs alone. The consultant radiologist should decide this, at the time of checking the films with the radiographers.
Appendix 3

Protocol for MRI examination of brain

Essential

- T1 and T2 weighted axial images, slice thickness 4mm (use “neonatal” angle- from inferior frontal lobe to torcula)
- T1 weighted sagittal, with thinner slices 1.5-3mm. Volume sequence is ideal as this can then be reformatted into coronal or transverse planes if needed for later comparison with histopathology.
- T2 coronal
- Diffusion weighted imaging with a generated ADC map

Desirable

- MR Sinus venogram
- MR proton spectroscopy in the basal ganglia/thalami (Echo time approx 135ms)
- MR Angiography
- FLAIR (optional)
- Use IV contrast if suspected acquired infection

Post mortem protocol

Use T1 and T2 weighted sequences from essential list above. T2 weighted images will have best quality. Do each sequence in all three planes. Increase signal averages to 3-4 to provide a better signal to noise ratio. Exam time may be increased but should be completed within an hour.
### Appendix 3

**Membership of the Steering Committee**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position and Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Julie-Clare Becher</td>
<td>Consultant Neonatologist, Simpson Centre for Reproductive Health, Edinburgh (Chair)</td>
</tr>
<tr>
<td>Dr Michael Ashworth</td>
<td>Consultant Paediatric Pathologist, Great Ormond St Hospital, London</td>
</tr>
<tr>
<td>Professor Jeanne Bell</td>
<td>Department of Neuropathology, University of Edinburgh</td>
</tr>
<tr>
<td>Miss Charlotte Bevan</td>
<td>Lay representative, Stillbirth and Neonatal Death Society</td>
</tr>
<tr>
<td>Professor R Neil Dalton</td>
<td>WellChild Laboratory, King's College London, Evelina Children's Hospital, London</td>
</tr>
<tr>
<td>Dr David Fitzpatrick</td>
<td>Consultant in Clinical Genetics, MRC Human Genetics Unit, Edinburgh</td>
</tr>
<tr>
<td>Professor Peter Fleming</td>
<td>FSID Research Unit, Institute of Child Life and Health, St Michael’s Hospital, Bristol</td>
</tr>
<tr>
<td>Miss Debby Gould</td>
<td>Head of Midwifery, UCL, London</td>
</tr>
<tr>
<td>Dr Jane Hawdon</td>
<td>Consultant Neonatologist, Institute for Women’s Health, UCL, London</td>
</tr>
<tr>
<td>Dr Jean Keeling</td>
<td>Perinatal Pathology, Edinburgh</td>
</tr>
<tr>
<td>Dr Andrew Lyon</td>
<td>Consultant Neonatologist, Simpson Centre for Reproductive Health, Edinburgh</td>
</tr>
<tr>
<td>Dr Amaka Offiah</td>
<td>Clinical Senior Lecturer, University of Sheffield</td>
</tr>
<tr>
<td>Professor Mary Rutherford</td>
<td>Perinatal Imaging, Imperial College, London</td>
</tr>
<tr>
<td>Dr Steve Walkinshaw</td>
<td>Consultant in Maternal and Fetal Medicine, Liverpool Women’s Hospital</td>
</tr>
</tbody>
</table>
Appendix 4

Organisations and representatives involved in the consultation process

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Representative(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coroner’s Association</td>
<td>Dr Roy Palmer, Head Coroner and HM Coroner</td>
</tr>
<tr>
<td></td>
<td>Southern District of London</td>
</tr>
<tr>
<td>Crown Office and Procurator Fiscal Service</td>
<td>Ms Linda Cockburn</td>
</tr>
<tr>
<td>Scottish Cot Death Trust</td>
<td>Dr John McClure, Chairman</td>
</tr>
<tr>
<td></td>
<td>Mrs Fiona Brown, Executive Director</td>
</tr>
<tr>
<td>BLISS</td>
<td>Mr Andy Cole, Chief Executive</td>
</tr>
<tr>
<td>International Stillbirth Alliance</td>
<td>Ms Anais Schwind</td>
</tr>
<tr>
<td>National Childbirth Trust</td>
<td>Ms Margaret Mannion</td>
</tr>
<tr>
<td>Foundation for the Study of Infant Death</td>
<td>Mr Andrew Boon and Ms Joyce Epstein</td>
</tr>
<tr>
<td>Royal College of Radiologists</td>
<td>Dr Laurence Abernethy</td>
</tr>
<tr>
<td>Royal College of Pathologists</td>
<td>Dr Michael Ashworth</td>
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<tr>
<td>Royal College of Paediatrics and Child Health</td>
<td>Professor Terence Stephenson</td>
</tr>
<tr>
<td>Scottish Pathologists Association</td>
<td>Dr Jean Keeling</td>
</tr>
<tr>
<td>British Association of Perinatal Medicine</td>
<td>Dr Bryan Gill</td>
</tr>
<tr>
<td>British Neuropathology Society</td>
<td>Professor Jeanne Bell</td>
</tr>
</tbody>
</table>