ORIGINAL ARTICLE

Non-viable delivery at 20–23 weeks gestation: observations and signs of life after birth

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Objective: To describe the outcome of labour, signs of life at birth, and duration of survival after delivery at 20–23 weeks gestation.
Design: An observational study using data from the Confidential Enquiry into Stillbirths and Deaths in Infancy 1995–2000.
Setting: All deliveries to mothers resident in Trent Health Region.
Patients: 1306 babies delivered at 20–23 weeks gestation.
Results: Termination of pregnancy accounted for 33% of deliveries at 20–23 weeks; these were excluded from further analysis. Spontaneous delivery occurred at a frequency of 2.5/1000 deliveries; 30% died before the onset of labour, 27% died during labour, and 35% showed signs of life at birth. Of the latter, 8% were not registered as statutory live births. Of the live born infants, the largest group (39%) had a heart beat but no other signs of life. There was no trend for infants of lower gestation to show fewer signs of life. Duration of survival varied widely (median 60 minutes at 20–22 weeks), and this did not increase with gestation until 23 weeks (median six hours), probably because of selective treatment. Survival curves are presented for each gestation group. At 23 weeks, 4.5% survived to 1 year of age; all were > 500 g birth weight. Below 23 weeks gestation, none survived, and 94% had died within 4 hours of age.
Conclusions: This information on surviving labour, signs of life at birth, duration of survival, and birth weight at 20–23 weeks gestation should help decision making in the management of pre-viable delivery.

The birth of an extremely premature infant around the margins of viability poses difficult management decisions for health professionals and parents. Judgments have to be made about whether an infant is "viable" and whether resuscitation should be started. Parents may not make a distinction between being "born alive" and their understanding of viability. Parents and professionals need accurate information about outcomes from a relevant population to support shared decision making. The UK EPICure studies[1 2] have provided early survival and late developmental outcome information after delivery at 20–25 weeks gestation in the United Kingdom. However, little information exists on which signs of life are manifest at birth in the pre-viable infant. This is relevant because opinion and guidelines[3–5] suggest that the decision to resuscitate should depend on the infant's condition at birth; yet live birth in itself may not be a good indicator of viability or later outcome. Such information may also be of value in informing parents what they can expect to see in their newborn infant immediately after delivery and to inform difficult decision making, with health professionals, about invasive treatments.

Our aim in this study was to describe the outcome of spontaneous labour and the signs of life after the birth of infants (who later died) delivered between 20 and 23 weeks gestation using data collected from the UK Confidential Enquiry into Stillbirths and Deaths in Infancy[6] (CESDI) in a geographically defined population.

METHODS

CESDI routinely collects information on all deliveries, including termination of pregnancy, 20 weeks gestation and beyond (or birth weight > 300 g if gestation is not known), and each live birth dying before 1 year of age. CESDI does not therefore collect data on infants who survive beyond 1 year of age. Gestation, for CESDI notification, is defined by a hierarchy based on date of last menstrual period, postnatal gestation assessment, or ultrasound performed before 20 weeks.[7] A "Rapid Reporting Form" of basic data is completed in the health district in which the delivery or death occurs. One section of the form has data fields for signs/observations in the first hour after delivery, which include presence or absence of audible cry, spontaneous breathing, and spontaneous heart beat. Active body movement, as a category, was introduced in 1997. Quantitative measurements such as heart or respiratory rate are not included, nor are resuscitation or intensive care details.

The Trent Regional Office for CESDI provided data on deliveries, from mothers resident in the Trent Health Region, at 20, 21, 22, and 23 completed weeks gestation resulting in a non live birth (termed late fetal loss by CESDI and including termination of pregnancy) and all live births, followed by subsequent death before 1 year of age in the six years 1995–2000. Birth weight and date and age at death was also extracted.

CESDI, by definition, only collections information on deaths. To include any survivors, we used the Trent Neonatal Survey[8] (TNS) which encompasses the same deliveries as CESDI but also captures survival to discharge home as well as Apgar score and some details of neonatal intensive care.

In the United Kingdom, all live births must be registered, together with fetal deaths (after 24 weeks). The latter are registered as stillbirths (England & Wales Section 41 of Births and Deaths Registration Act 1953, amended by the Stillbirths (Definition) Act 1992).

Abbreviations: CESDI, UK Confidential Enquiry into Stillbirths and Deaths in Infancy; TNS, Trent Neonatal Survey; ONS, England and Wales Office of National Statistics

Table 1 All deliveries at 20–23 weeks gestation to mothers resident in Trent region 1995–2000

	Gestation (weeks)				
	20	21	22	23	Total
All deliveries	333	313	314	346	1306
Termination of pregnancy*	162	130	89	56	437 (33)
Deliveries excluding termination of pregnancy	171	183	225	290	869
Late fetal loss					
Before labour	73 (43)	61 (33)	69 (31)	61 (22)	264 (30)
During labour	50 (29)	63 (34)	60 (27)	61 (22)	234 (27)
Not known/recorded	27	22	12	6	69 (8)
Live birth	21 (12)	37 (20)	84 (37)	162 (56)	304 (35)
Alive at 4 hours of age	2	0	7	71	
Alive at discharge home	0	0	0	13	

Values in parentheses are percentages.
*Legal abortion notifiable under 1992 Abortion Act.

CESDI can cross validate ascertainment with registered live births and deaths held by the England and Wales Office of National Statistics (ONS). There is no validation system for in utero deaths before 24 weeks as there is no statutory requirement to register these events. In this study, validation was performed for live births occurring 1997–2000 (ONS years 1995 and 1996 were not available) to determine what proportion of CESDI reported live births were registered with ONS as live births.

The World Health Organisation ICD10[9] definition of "live birth", which is accepted in the United Kingdom for the purposes of registration and refined by CESDI, is as follows: "complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of pregnancy, which after separation, breathes or shows evidence of life, such as beating of the heart, pulsation of the umbilical cord, or definite movements of voluntary muscles, whether or not the umbilical cord has been cut or the placenta is attached; each product of such a birth is considered liveborn". CESDI further specifies that detectable pulsation as a result of cardiac massage is not a valid sign and that a respiratory gasp has to be spontaneous and active, rather than as a result of resuscitation attempts in order to be considered a valid sign of life.[7]

RESULTS

The total number of deliveries at 20 weeks gestation and beyond to mothers resident in Trent Health Region between 1995 and 2000 was 347 835. CESDI Rapid Reporting Forms for the same region and years but for deliveries at 20–23 completed weeks gestation showed 1293 deliveries, and the TNS added 13 survivors (all at 23 weeks) giving a total of 1306. A third (437) were terminations of pregnancy (1992 Abortion Act) and are excluded from further analysis (table 1). The remaining 869 represent a delivery rate at 20–23 weeks gestation of 2.5/1000 deliveries. Table 1 summarises the data by gestational age and shows that 65% of fetuses (565) died before delivery; 30% (264) had died before the onset of labour with a significant trend for more deaths at lower gestation; 27% of fetuses (234) died during labour. Thus 304 (35% of deliveries) showed signs of life at birth, and the proportion of live births increased with gestational age from 12% at 20 weeks to 56% at 23 weeks gestation (table 1).

Comparisons of CESDI reported live births with ONS registered live births were made for the years 1997–2000. Only 92% (194/210) of CESDI reported live births were ONS registered, indicating some under-reporting of statutory live births at these gestations. This was consistent across the gestational range 20–23 weeks.

Table 2 shows summary descriptive centiles for birth weight at each gestation for all live births delivered at 20–23 completed weeks gestation. The average birth weight of live born infants for the group as a whole was 102 g higher than late fetal loss deliveries (unpaired *t* test $p < 0.0001$), reflecting arrested fetal growth because of death at a variable period before delivery in the latter group.

Table 2 Birthweight centiles of live births at 20, 21, 22, or 23 weeks gestation

	Birth weight (g)			
	20	21	22	23
98th centile	431	558	665	730
50th centile	323	400	490	580
2nd centile	228	228	358	375
n=283	20	36	80	160

Eight live born infants did not have birth weight recorded.

Figure 1 shows signs of life observed in the first hour after delivery, where "audible cry" and "spontaneous breathing" categories have been combined and taken as indicative of respiratory effort. The largest group (114, 39%) had a spontaneous heart beat but no other signs of life; 13% (39) were crying, breathing, and actively moving with a heart beat; 12% of infants (36) were recorded as having cry/breathing or active body movement but no spontaneous heart beat. We wanted to explore whether infants of lower gestation were less "vigorous" at birth by analysing the signs of life according to how many categories were present at each gestational age. There was no significant trend (χ^2 for trend) for infants of lower gestation to show fewer signs of life than those more mature infants within the 20–23 week gestational band studied.

For live births, the time interval between delivery and first diagnosed death varied considerably; for example, at 20 weeks gestation the median survival time was 80 minutes (95% confidence interval 38 to 122 minutes), whereas at 23 weeks gestation the median survival time was six hours (95% confidence interval 1 h 55 min to 10 h 19 min). Figure 2 shows survival probability curves for each gestation over the first 12 hours. In the range 20–22 weeks, many infants died within minutes of delivery, 50% (71/142) within the first hour, and 94% (133/142) within four hours, and there was no significant trend for longer duration of presence of vital signs with gestation (χ^2 test for trend). At 23 weeks gestation it is likely that the time to death was prolonged, in many cases, by resuscitation in the delivery room. Neither CESDI nor TNS collect details of resuscitation.

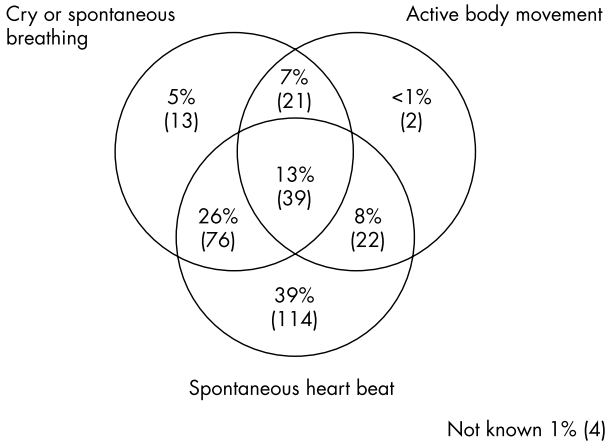

Figure 1 Combinations of signs of life in the first hour after delivery at 20–23 weeks gestation (CESDI data only).

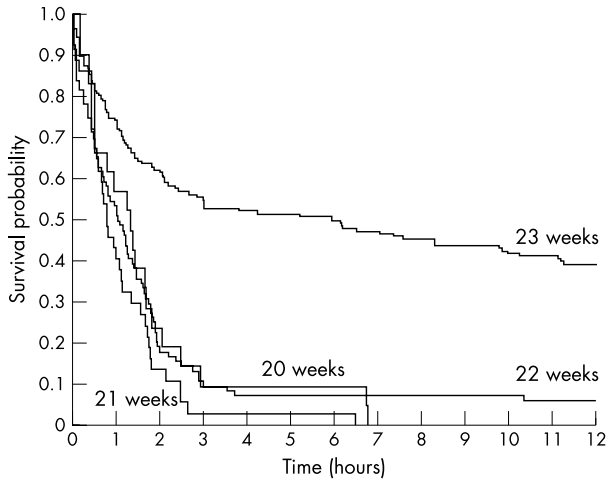

Figure 2 Survival probability curves for infants dying after live birth at 20–23 weeks gestation. The time axis is truncated at 12 hours of age for clarity.

Using the TNS we confirmed that no infants below 23 weeks gestation survived to discharge, and at 23 weeks gestation 13 out of 162 (8%) survived to discharge with no further deaths within the first year of life.

Some authors[3 10] have recommended that, below 500 g birth weight, active resuscitation may not be appropriate. We therefore explored this weight threshold in our CESDI data (500 g is below the 50th centile for 22 weeks (table 2)). At 23 weeks 69% (111/162) were > 500 g birth weight, at 22 weeks 35% (29/84) were > 500 g, at 21 weeks 8% (3/37) were > 500 g, and at 20 weeks there were no live births > 500 g (0/21). Among live births at 20–22 weeks gestation below 500 g (104/142), only 3% (3/104) were still alive at 4 hours of age. At 23 weeks, 23% (38/162) of live births were below 500 g, and of these 18% (7/38) were alive at 4 hours. None of the 13 long term survivors at 23 weeks gestation were below 500 g birth weight, and in this group birth weight (mean 615 g, range 500–730) was not significantly different from non-surviving live births (mean 567 g, range 360–800).

We wanted to determine whether the presence of active breathing or crying after birth predicted time to death. We compared duration of survival of 20–22 week gestation infants in those recorded as having a heart beat alone (57) with those showing breathing or crying activity (85). Survival was shorter in those with heart beat alone (median 40 minutes) than in those breathing or crying (median 70 minutes) ($p = 0.04$, Mann-Whitney test). However, this is of little clinical predictive value because of the wide range of survival time in both groups. Birth weight was not significantly different between these two groups. Similarly, among the 13 long term surviving 23 week gestation infants (TNS data), signs of life at birth judged by Apgar score were too widely spread to be helpful in predicting survival in individuals (one minute Apgar score, median 5 (range 1–9)).

DISCUSSION

This study provides information on the likelihood of survival during labour and observations about the presence and duration of signs of life in deliveries in the pre-viable gestation range 20–23 weeks, from a large geographically defined population. This information may help parents and professionals to make difficult shared management decisions before delivery.

The proportion of deliveries resulting in infants born alive at these extremes of gestation has shown some variation between studies of a similar nature. For example in the UK EPICure study,[1] 11% of deliveries at 20–22 weeks gestation showed signs of life, whereas the same analysis for our data showed 25% (142/579) were live born (table 1). Two North American series reported 40%[9] and 76%[10] live births at 22 weeks gestation, and in a third study[10] reporting on birth weight below 500 g, 32% were live born. To account for this variation, some consideration of differing study design is required. Firstly, not all published studies count or specify whether termination of pregnancy is included in the number of deliveries making up the denominator; in our study these were counted and excluded and made up about one third of deliveries at 20–23 weeks gestation. Obviously, these should be excluded from any considerations about viability or signs of life after delivery. Secondly, observations of signs of life after birth may vary in different delivery settings attended by a variety of healthcare professionals unless the method of recording is standardised. To date, no studies have included measurements of vital signs, such as heart rate or breathing rate, at set intervals after delivery so there is likely to be some scope for variation in recording these.

The WHO[9] and CESDI[7] definition of live birth and the pragmatic acceptance of "any signs of life" is widely practised among health professionals, but is nevertheless open to subjective interpretation. Recording of "observation/signs of life in the first hour" on the CESDI Rapid Reporting Form would not, in most instances, be completed by the health professional attending the delivery. It is generally derived retrospectively from midwifery or medical records. In this respect, the data may be biased in favour of under-reporting of signs of life and hence live births. Health professionals, having judged the delivery to be non-viable (and possibly counselled the parents as such), may under-record signs of life—for example, slow heart beat for a few minutes only—in the belief that this may minimise parental distress and the need to register the birth. Comparison with ONS data indicated that a proportion of infants with any sign of life (reported to CESDI) are not statutory registered with ONS as live births (8%). Wide variation in the proportion of births registered as live or stillborn has been noted previously,[12 13] perhaps because of judgments about viability and the appropriateness of initiating resuscitation or intensive care. This variation cannot be controlled for in a study such as ours.

Furthermore, because our study is observational, it cannot determine the impact of any intervention such as resuscitation or initiation of intensive care on duration of survival.

CESDI only includes deaths to 1 year of age and hence does not include any survivors beyond 1 year of age. By using TNS data, however, we confirmed that there were no survivors below 23 weeks gestation and at 23 weeks gestation 13 (8%) survived to go home and survive to at least 1 year of age.

We believe it is reasonable to assume that our observations on infants of 20–22 weeks gestation are representative of

infants dying, having only rarely been given active treatment, whereas at 23 weeks gestation many will have received resuscitation and intensive care before death.

CESDI and TNS describe signs of life at birth in different ways (TNS uses Apgar scores), so it was not possible to directly compare signs of life at birth between long term survivors at 23 weeks (n = 13) with non-survivors (n = 149), but it was clear that the wide range of Apgar scores at one and five minutes, in this small number of infants, precluded any prediction of likelihood of survival, based on Apgar score, in any individual infant.

Survival in Trent was comparable to other studies. The UK EPICure study[1] showed that, among live births believed to be 23 weeks gestation at birth, 11% survived to discharge (at 22 weeks gestation, 1% (two babies) survived to discharge). Another study[10] specifically addressed infants with a birth weight below 500 g and like our data showed, high mortality (78%) on the first day of life. In this study 4.7% of live births below 500 g survived to discharge home but with further late deaths and few intact survivors. In Trent there were no survivors with a birth weight below 500 g.

The EPICure study[1] did not report resuscitation details, so, in common with other published series, it is difficult to estimate the impact of delivery room resuscitation or intensive care on duration of survival. However, surfactant therapy was administered to 12% of babies at 22 weeks and 42% at 23 weeks gestation. In a North American series[4] resuscitation was initiated in 43% of deliveries at 22 weeks and 91% at 23 weeks.

We found that late fetal loss deliveries had a significantly lower average birth weight when compared with live births (by 109 g). This can be explained by the proportion of late fetal loss deaths that will have occurred some weeks before delivery at 20–23 weeks gestation.

Our findings on the presence and duration of heart rate, breathing or crying, and active body movements, must be considered as approximations only. They do nevertheless provide a framework of information for professionals to discuss with parents before delivery. Parents, unless adequately prepared and informed beforehand, are often distressed by the length of the dying process after non-intervention or treatment withdrawal in the neonatal intensive care unit.[14] Knowledge about the baby's size, appearance, and presence or absence of specific signs of life may better inform parents' (and professionals') expectations and prepare them for the birth of the pre-viable infant.

We would recommend that the CESDI Rapid Reporting Form should incorporate additional data fields for details of resuscitation and early neonatal intensive care to facilitate further research into the management of birth at the margins of viability.

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