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Papers

Classification of stillbirth by relevant condition at death (ReCoDe): population based cohort study

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Abstract

Objective To develop and test a new classification system for stillbirths, to help improve understanding of the main causes and conditions associated with fetal death.
Design Population based cohort study.
Setting West Midlands region.
Subjects 2625 stillbirths from 1997 to 2003.
Main outcome measures Categories of death according to conventional classification methods and a newly developed system (ReCoDe, relevant condition at death).
Results By the conventional Wigglesworth classification, 66.2% of the stillbirths (1738 of 2625) were unexplained. The median gestational age of the unexplained group was 237 days, significantly higher than the stillbirths in the other categories (210 days; $P < 0.001$). The proportion of stillbirths that were unexplained was high regardless of whether a postmortem examination had been carried out or not (67% and 65%; $P = 0.3$). By the ReCoDe classification, the most common condition was fetal growth restriction (43.0%), and only 15.2% of stillbirths remained unexplained. ReCoDe identified 57.7 % of the Wigglesworth unexplained stillbirths as growth restricted. The size of the category for intrapartum asphyxia was reduced from 11.7% (Wigglesworth) to 3.4% (ReCoDe).
Conclusion The new ReCoDe classification system reduces the predominance of stillbirths currently categorised as unexplained. Fetal growth restriction is a common antecedent of stillbirth but its high prevalence is hidden by current classification systems. This finding has profound implications for maternity services, and raises the question whether some hitherto "unexplained" stillbirths may be avoidable.

Introduction

Stillbirths are the largest contributor to perinatal mortality, but current classification systems consistently report about two thirds of stillbirths as being unexplained.[1] Recent figures show a rise in stillbirth rates in England and Wales, and an increase to 71% of cases that are classified as unexplained.[2]

The preponderance of fetal deaths ending up in a non-specific or unexplained category occurs despite three classification methods used on the rapid report forms of the Confidential Enquiry into Stillbirths and Deaths in Infancy in England, Wales, and Northern Ireland, and the perinatal death notifications of the Confidential Enquiry into Maternal and Child Health, which has replaced the Confidential Enquiry into Stillbirths and Deaths in Infancy. These methods are the pathophysiological classification by Wigglesworth,[3] the fetal and neonatal classification[4] based on a system first described by Bound et al in 1954[5] and applied in the 1958 British mortality survey,[6] and the revised obstetric (Aberdeen) classification,[7] which is based on a method first described by Baird et al in 1954.[8]

Any classification system that results in such a high proportion of cases being defined as unexplained would seem not to be fulfilling its purpose, which is to help clinicians to understand what went wrong and to derive learning points for best practice; to assist in counselling bereaved mothers and families about the loss, the underlying reasons, and prospects for the future; and to aid public health specialists and commissioners to prioritise health service resources and strategies for prevention.

We developed a classification system for defining relevant clinical categories for stillbirth and tested the method on a seven year dataset of stillbirths in the West Midlands.

Methods

The data for our study were derived from rapid report forms submitted to the Perinatal Institute by local coordinators in all maternity units in the West Midlands. Ascertainment of cases is comprehensive and also regularly checked against data from the Office for National Statistics. We analysed data on all stillbirths occurring in the West Midlands population between 1997 and 2003. Data included the date of delivery; gestational age; maternal characteristics, including parity and ethnic group; the baby's sex and birth weight; and pregnancy details to ascertain cause of death, including results of any postmortem examination. The forms list the primary and sometimes secondary causes, which are used to code the relevant classifications. We obtained the denominators (all stillbirths and live births) from data on vital statistics from the Office for National Statistics.

Classification

Our new classification system (box) seeks to identify the relevant condition at the time of death in utero. The system is based on the following principles:

- Stillbirths are distinct from neonatal deaths and warrant their own classification
- Subclassification according to gestational age is not needed, as prematurity is not a relevant cause or condition for stillbirth
- No subclassification is given according to weight, but one related to fetal growth status, based on weight for gestation
- The system seeks to establish what went wrong, not necessarily why (as the classification does not have to rely on finding an underlying cause, more than one category can be coded if the information is available)

- The hierarchy starts from conditions affecting the fetus and moves outwards in simple anatomical groups, which are subdivided into pathophysiological conditions
- The primary condition should be the first on the list that is applicable to a case.

Fetal growth restriction is included as the last category in group A (A7): because of the hierarchical structure of the classification system, a fetus below the 10th customised centile would be assigned this classification only if none of the other specific fetal conditions was present. Secondary coding can be used to increase descriptiveness while maintaining a hierarchy of groups A to I to reflect clinical relevance. For example, a stillbirth with evidence of fetal growth restriction and maternal pre-eclampsia would be coded A7 F4.

Classification system according to relevant condition at death (ReCoDe)

Group A: Fetus

1. Lethal congenital anomaly
2. Infection
   2.1 Chronic
   2.2 Acute
3. Non-immune hydrops
4. Isoimmunisation
5. Fetomaternal haemorrhage
6. Twin-twin transfusion
7. Fetal growth restriction*

Group B: Umbilical cord

1. Prolapse
2. Constricting loop or knot†
3. Velamentous insertion
4. Other

Group C: Placenta

1. Abruptio
2. Praevia
3. Vasa praevia
4. Other "placental insufficiency"‡
5. Other

Group D: Amniotic fluid

1. Chorioamnionitis
2. Oligohydramnios†
3. Polyhydramnios†
4. Other

Group E: Uterus

1. Rupture
2. Uterine anomalies
3. Other

Group F: Mother

1. Diabetes
2. Thyroid diseases
3. Essential hypertension
4. Hypertensive diseases in pregnancy
5. Lupus or antiphospholipid syndrome
6. Cholestasis
7. Drug misuse
8. Other

Group G: Intrapartum

1. Asphyxia
2. Birth trauma

Group H: Trauma

1. External
2. Iatrogenic

Group I: Unclassified

1. No relevant condition identified
2. No information available

*<10th customised weight for gestational age centile.
†If severe enough to be considered relevant.
‡Histological diagnosis.

Classification of 2625 stillbirths according to Wigglesworth[2]

Code	Description	No (%)
A	Congenital defect or malformation	389 (14.8)
B	Unexplained antepartum fetal death	1738 (66.2)
C	Death from intrapartum asphyxia, anoxia, or trauma	307 (11.7)
D	Immaturity	NA
E	Other (infection, other specific causes, accident)	170 (6.5)
F	Unclassifiable or unknown	21 (0.8)

NA=not applicable.

Birth weight for gestation centile

We calculated customised centiles along previously described principles,[9 10] using the gestation related optimal weight software, GROW, version 4.6, 2003 (www.gestation.net). This program calculates the fetal growth potential by adjusting for the fetus's sex and constitutional characteristics known at the beginning of each pregnancy: maternal height and weight, parity, and ethnic origin. The actual birth weight is then compared with the optimal weight predicted for the corresponding gestation, and a "customised centile" is calculated. The method improves the distinction between constitutional and pathological smallness for gestational age,[11 12] allowing customised smallness for gestational age to be used synonymously with fetal growth restriction. For missing data such as maternal height or weight at booking, we used population averages (165 cm and 63 kg, respectively).

The calculation of the centile required an estimation of gestational age at the time of death. Although severe maceration would suggest that the dead fetus had stayed longer in utero, this observation was recorded only rarely and was not considered reliable for assessing the time of death. As in previous analyses of stillbirth weight,[11 13] we deducted two days from the gestational age at delivery of each stillborn fetus. This is taken as the average estimated time interval in the third trimester between fetal death and delivery, based on Genest et al's series of histopathological studies.[14]

Results

Overall, 2625 stillbirths and 451 197 births occurred during the seven year period between 1997 and 2003, representing an average stillbirth rate of 5.82 per 1000.

The table lists the causes of death according to the Wigglesworth[3] classification, which is the one most commonly used for national statistics.[1] The largest category, 66.2%, was for unexplained antepartum fetal death, and 11.7% of deaths were associated with intrapartum causes. An equivalent unexplained category was also the largest by both other commonly used classification methods: the fetal and neonatal classification[4] (66.2%) and the revised obstetric (Aberdeen) classification (52.7%).[5]

The average (median) gestational age at delivery of the stillbirths denoted as unexplained by the Wigglesworth classification was significantly higher than the gestational age of the stillbirths that fell into the other Wigglesworth categories (237 *v* 210 days; $P<0.001$, Mann-Whitney U).

A total of 1241 of the 2625 stillbirths (47.3%) had a postmortem examination. The proportion of stillbirths that were unexplained was high regardless of whether a postmortem examination had been carried out: 810 of 1241 (65.3%) of stillbirths that underwent a postmortem examination and 928 of 1383 (67.1%) of stillbirths that did not were assigned to the unexplained category (P = 0.3).

The figure shows the results using the ReCoDe classification. On the left of the figure is the primary classification, with frequencies and percentages for each condition. Only 398 (15.2%) cases remained unclassified as "no relevant condition identified" (I1). The largest category of stillbirths was A7, fetal growth restriction (43.0%). Of the 1738 unexplained stillbirths according to the Wigglesworth classification (see table), the ReCoDe system identified 1002 (57.7%) as growth restricted.

Information on classification of a secondary condition was available on 1146 (43.7%) of the rapid report forms. These are listed on the right of the figure. A wide spread of secondary conditions can be observed for several of the primary classifications. In particular, this analysis shows that a large proportion of congenital anomalies were also growth restricted; among the primary fetal growth restriction group (A7), the most common secondary codes were placental abruption, oligohydramnios, maternal hypertensive disease, and intrapartum asphyxia; and intrapartum asphyxia was often a secondary code for stillbirth associated with abruptio.

Overall, the ReCoDe system showed a smaller proportion of deaths in the intrapartum group than did the Wigglesworth classification (3.4% *v* 11.7%). As suggested from the secondary coding analysis (see figure), this was because many cases of intrapartum asphyxia were assigned other primary conditions under the ReCoDe system. Fetal growth restriction and placental abruptio together accounted for 99 (63%) of the 156 cases with a secondary coding of intrapartum asphyxia.

Discussion

This analysis of a seven year regional cohort of stillbirths showed that the new ReCoDe (relevant condition at death) classification enabled 85% of cases of stillbirth to be assigned a relevant condition, leaving only 15% as unclassified or unexplained. On the same data, the conventional Wigglesworth classification left 66% of stillbirths unexplained, which is consistent with the reported national rate of unexplained stillbirth.[1 2] This raises doubts as to whether classification systems that leave most stillbirths in an unexplained category still have a place in modern perinatal audit. The risk is that "unexplained" may be regarded as synony-

A Primary ReCoDe classification			Number in category	Proportion of total (%)	B Secondary ReCoDe classification: Infection	Non-immune hydrops	Isoimmunisation	Fetomaternal haemorrhage	Twin-twin transfusion	Fetal growth restriction	Prolapse	Constricting loop or knot	Velamentous insertion	Umbilical cord - other	Placental abruptio	Placenta praevia	Vasa praevia	Placental insufficiency	Placenta - other	Chorioamnionitis	Oligohydramnios	Polyhydramnios	Rupture of uterus	Uterine anomalies	Uterus - other	Diabetes	Thyroid diseases	Essential hypertension	Hypertensive diseases in pregnancy	Lupus or antiphospholipid syndrome	Cholestasis	Drug misuse	Mother - other	Intrapartum asphyxia	Birth trauma	External trauma	Iatrogenic trauma	Total having secondary code	Proportion (%) with secondary code
					A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	E1	E2	E3	F1	F2	F3	F4	F5	F6	F7	F8	G1	G2	H1	H2		
Fetus	Lethal congenital anomaly	A1	391	14.9	2	33			3	204	1									2	11	5				4	1							7				273	69.8
	Infection	A2	79	3.0		3				25	1	2			1				3	39					1		1						1				77	97.5
	Non-immune hydrops	A3	36	1.4			1		3	7					1					1	1												3				17	47.2
	Isoimmunisation	A4	11	0.4						5	1				1																						7	63.6
	Fetomaternal haemorrhage	A5	5	0.2						1		1																					1				3	60.0
	Twin-twin transfusion	A6	38	1.4						19												4					1						2				26	68.4
	Fetal growth restriction	A7	1129	43.0							7	71			159	2		53	28	12	50	2			18		6	80	2		1	10	53				554	49.1
Cord	Prolapse	B1	12	0.5											1				2														4				7	58.3
	Constricting loop or knot	B2	75	2.9										1	2				2			1			2								12				20	26.7
	Velamentous insertion	B3	0	0.0																																	0	0.0
	Umbilical cord - other	B4	0	0.0																																	0	0.0
Placenta	Placental abruptio	C1	181	6.9												1	1	3	8	1	1	2						13		1		1	46		1		79	43.6
	Placenta praevia	C2	6	0.2															1														2				3	50.0
	Vasa praevia	C3	2	0.1															2																			2	100.0
	Placental insufficiency	C4	18	0.7															1	2					1								1				5	27.8
	Placenta - other	C5	25	1.0																1	1	3				1							11				17	68.0
Amniotic fluid	Chorioamnionitis	D1	10	0.4																	2							1					3				6	60.0
	Oligohydramnios	D2	7	0.3																							1						2				3	42.9
	Polyhydramnios	D3	3	0.1																						1							1				2	66.7
Uterus	Rupture	E1	3	0.1																																	0	0.0
	Anomalies	E2	0	0.0																																	0	0.0
	Uterus - other	E3	0	0.0																																	0	0.0
Mother	Diabetes	F1	35	1.3																							2	2	3				25	1			33	94.3
	Thyroid diseases	F2	1	0.0																													1				1	100.0
	Essential hypertension	F3	2	0.1																									2								2	100.0
	Hypertensive diseases in pregnancy	F4	21	0.8																													4				4	19.0
	Lupus or antiphospholipid syndrome	F5	1	0.0																												1					1	100.0
	Cholestasis	F6	1	0.0																												1					1	100.0
	Drug misuse	F7	1	0.0																																	0	0.0
	Other maternal condition	F8	24	0.9																													2				2	8.3
Intrapartum	Intrapartum asphyxia	G1	88	3.4																															1		1	1.1
	Birth trauma	G2	0	0.0																																	0	0.0
Trauma	External trauma	H1	0	0.0																																	0	0.0
	Iatrogenic trauma	H2	1	0.0																																		
Unclassified	No relevant condition identified	I1	398	15.2																																		
	No information available	I2	21	0.8																																		
Total			2625	100.0	2	36	1	0	6	261	10	74		1	165	3	1	56	47	58	66	17	0	0	0	28	3	11	99	2	1	1	39	156	0	2	0	1146	43.7

Classification of stillbirths in West Midlands, 1997-2003 using the ReCoDe (relevant condition at death) system

mous with "unavoidable," which could lead to the complacent conclusion that little can be done about them.

The single largest condition associated with stillbirth is failure of fetal growth. Such a link does not become evident when perinatal mortality is presented in separate groupings for weight and gestational age.[15 16] Making comparisons within weight categories—that is, controlling for birth weight,[17] can also obscure the fact that many deaths in utero are of fetuses that are smaller than they should be at that gestational age. Nevertheless, even with conventional classification methods, low birth weight emerges as the single largest category.[18]

The extent of the link between stillbirth weight and death becomes most apparent when weight is corrected for gestation. Williams et al[19] analysed fetal deaths on population based centile curves in California and showed a strong link between fetal weight for gestation and death. Similar associations were found in English[13] and Swedish populations.[11] Using measures of smallness for gestation within perinatal death classification systems can result in fewer stillbirths in the unexplained category.[20 21]

Smallness for gestation has a demonstrable link with fetal death at the population level. However, individually each fetus may be either physiologically or pathologically small, and could be inappropriately classified if only weight for gestation is used. Our classification system therefore uses individually adjustable, customised weight centiles to define which babies had fetal growth restriction. Between a quarter and a third of babies considered small for gestational age (<10th centile) by general population based weight standards are in fact small-normal and have no increased risk of perinatal morbidity or mortality.[11 12] A corresponding proportion of babies who should be considered as pathologically small are missed by uncustomised standards, and these have been shown to have an increased risk of perinatal morbidity and mortality.[11 12] Within subgroups of the population (for example, ethnic minorities) the proportion of false positive and false negative definitions of pathological smallness is even higher.

The use of customised centiles for weight allows us not only to quantify the overall strength of association between stillbirth and pathological smallness, but also to identify in each individual case whether the stillbirth occurred after poor fetal growth. Although not strictly a cause of death, fetal growth restriction is an important condition present at the time of fetal death.

The analysis of secondary codes (see figure) provides further insight into the conditions leading to stillbirth. Growth restriction is known to have an association with placental abruption and is shown here to have been often present when the abruptio occurred. Similarly, many instances of intrapartum asphyxia resulting in stillbirth were of babies who were already growth restricted.

The category of deaths due to intrapartum asphyxia was much smaller when classified by the ReCoDe system (3.4%) than by the Wigglesworth classification (11.7%). The intrapartum category turns up more often as a secondary classification (see figure). Many of these deaths are identified as having another primary condition such as fetal growth failure, highlighting the importance of this condition as an antecedent of intrapartum death. This is consistent with the emerging consensus of a much more important contribution of antepartum, compared with intrapartum, factors on adverse pregnancy outcomes such as cerebral palsy.[22] The finding would support the notion that good intrapartum care begins earlier in pregnancy: the antepartum course affects the fetus's reserve and ability to withstand stress, and is therefore relevant for determining the appropriate level of surveillance during labour.

What is already known on this topic

Stillbirths are the largest contributor to perinatal mortality

The current method of classifying perinatal deaths results in at least two thirds of stillbirths being classified as unexplained

What this study adds

A new classification system (ReCoDe) can identify relevant conditions at the time of fetal death in 85% of cases

Fetal growth restriction is the single largest category of conditions associated with stillbirth and is found in the majority of the cases previously considered unexplained

Most stillbirths occurred at gestations when the baby would be mature enough to not only survive but to do well, if it could be delivered in good condition. This shifts the emphasis on the identification, diagnosis, and management of fetal growth problems. Prospective surveillance can result in the timely delivery of a fetus at risk from an unfavourable intrauterine environment. This is now assisted by ultrasound imaging and biophysical assessment with umbilical artery Doppler, which has been shown to improve outcome and reduce the number of fetal deaths.[23] The main problem facing expectant mothers and clinicians, however, is the lack of recognition within the general maternity population of fetuses with growth problems that are in need of referral for further investigation. In everyday practice, only about a quarter of small for gestational age babies are detected as such antenatally.[24] This problem was again highlighted in a reanalysis of the report of the one in 10 inquiry of the Confidential Enquiry into Stillbirths and Deaths in Infancy[1] and in a summary of the EuroNatal study from 10 European countries,[1] where the single largest factor associated with substandard care was the lack of antenatal detection of intrauterine growth restriction.

The strong link between fetal growth failure and stillbirth has important implications for health policies and preventive strategies, including the need to enhance efforts to improve the antenatal detection of fetal growth restriction.

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