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Classifying stillbirths in a tertiary care hospital of India: International Classification of Disease-perinatal Mortality (ICD-PM) versus cause of death-associated condition (CODAC) system

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ABSTRACT

A number of classification systems are available to classify stillbirths, but there remains a lack of a uniform global system of classification. This study evaluated the feasibility of the ICD-PM classification system and COD-AC to classify the stillbirths and to discuss the interpretation of “the newer” classification system (ICD-PM) over the COD-AC system. Over a period of one year, out of 5776 total births 314 were stillborns with a stillbirth rate of 54 per 1000 total births. As per ICD PM Classification System, 69.1% of stillbirths were ante partum and rest intrapartum. The associated maternal conditions at the time of foetal death were also classified into five groups and maximum mothers (44.3%) were grouped under M4-medical/surgical disorders. According to COD-AC system of classification 90% of cases were assigned the cause of death, rest 10% remained unexplained. The ICD-PM and CODAC classification both seem to be feasible but ICD-PM clearly defines the time of foetal death and correlates fetomaternal dyad together.

IMPACT STATEMENT

- **What is already known on this subject?** Classifying stillbirths is crucial to recognise the actual cause of foetal death and to gather the relevant information for planning the preventive strategies especially in low middle-income countries (LMICs) which contribute to 98% of total global burden of 2.6 million stillbirths annually. In literature CODAC system was found most suitable for low middle-income countries. In 2016, WHO proposed a newer system, i.e., ICD-PM: WHO application of ICD-10 to deaths during the perinatal period.
- **What do the results of this study add?** With ICD-PM classification stillbirths were categorised more clearly in different groups and fetomaternal condition were linked together along with both intrapartum and ante partum stillbirth which can help to set the priorities and future planning for prevention. The proportion of unexplained stillbirth has also reduced significantly compared to CODAC system.
- **What are the implications of these findings for clinical practice and/or further research?** ICD-PM system of classification seems feasible and would facilitate the uniform and consistent stillbirth data even from LMICs for global comparison although more number of studies are needed for conclusion. The system has been changed to ICD-PM in our institute.

KEYWORDS

Stillbirth; stillbirth rate; cause of death-associated condition (COD-AC); ICD-PM International Classification of Disease; perinatal mortality

Introduction

Stillbirths were first notified in Scotland in 1940. For surveillance & audit purpose, the first classification was developed by Baird et al. in 1954 (Baird et al. 1954). Since this time, a large number of classification systems have been developed by clinicians, epidemiologists & researchers to understand the aetiology of stillbirth in various contexts. The purpose of any classification system is to know the actual burden of any particular problem and its causes for planning the preventive strategies (Whitfield et al. 1986). However, until very recently no uniform classification system was developed specifically which could be applied to both High income countries (HIC)

and Lower middle income countries (LMICs) settings (Reinebrant et al. 2018).

There are inherent challenges in identifying and ascertaining the cause of stillbirth as there is always an overlap between actual cause, associated condition and risk factors. Another major challenge is to obtain the complete history i.e., information of maternal, foetal and placental conditions. Extensive postnatal evaluation (perinatal autopsy, placental examination, genetic testing) may not be feasible in a country like India. To make an international comparison, LMICs also need to follow an accurate and consistent system of classification. A classification system needs to identify the most appropriate clinical cause of death and needs to be

simple and reproducible. In a recent Delphi study, 17 characteristics for a classification system were reported; some emphasise the risk factors which are suitable for epidemiology and health care planning, while a few represent probable clinical cause of death. Out of these, a global system must have at least five characteristics: (1) easy to use and produce data; (2) clear guidelines; (3) able to work with all levels (HMIC & LMIC); (4) ensures causes of death categories to be relevant in all settings; (5) produce data for preventive strategies (Wojcieszek et al. 2016). India has adopted CODAC (Cause of death and Associated conditions, the system which finds out the most appropriate cause of death along with associated conditions and promises to be good for LMIC where limited information is available (or whatever information is gathered by verbal autopsy) (Frøen et al. 2009). In our institute, CODAC classification system is being followed since 2014.

WHO recommends the use of the International Classification of Disease (ICD) to classify deaths at any age, including stillbirths. However, the variation in the application of ICD-10 to stillbirths limited the comparability of cause of stillbirth across different settings and need of further guidance was clearly seen. Therefore in 2016, WHO developed revised guidance on the application of ICD 10 for perinatal deaths i.e., during pregnancy, child birth and puerperium—the ICD—PM classification, seeking to create the first guidance on a global system for classifying still births (Alanson 2015, 2016) The ICD-PM classification is a multilayered approach to identify the single cause of death and it actually captures the time of perinatal death, i.e., ante partum, intrapartum and neonatal period. It also links the perinatal deaths with maternal condition (Allanson et al. 2016).

The present study was aimed to examine the feasibility of ICD-PM classification system and CODAC to classify the Stillbirths who delivered in a single tertiary care centre of northern India and to discuss the interpretation of this newer classification system (ICD-PM) over the CODAC system.

Methodology

This study was a prospective observational study conducted in the department of obstetrics and gynaecology of a tertiary care centre of northern India over a period of one year from November 2016 to October 2017. Our Labour room caters to mostly referrals of high risk pregnancies with an average of 6000 deliveries per year. All the stillbirths delivered during study period either booked, unbooked or referrals were included after informed consent.

Stillbirth is defined as the birth of a baby with no sign of life after 20 weeks or a birth weight of ≥ 500 g. Each stillbirth was evaluated thoroughly from case records, available investigations and open history gathered from patient and her relatives during hospital stay. The most appropriate cause for foetal death was assigned with available investigations by the team of obstetrician which includes doctors who managed the woman and BS, NA who reviewed each case separately. The investigator (BS, NA) used this information to classify each death according to CODAC and ICD-PM Classification. For

CODAC the most probable cause was assigned as the cause and associated conditions were also captured. As per COD-AC cause of death each foetal is categorised into ten categories (infections, intrapartum, foetal, cord, placenta, maternal conditions, unknown, etc.) and two associated conditions (perinatal and maternal) (Frøen et al. 2009).

Then the same cases of stillbirths were classified as per ICD- PM by assigning the timing of foetal death, into two groups ante partum (before the onset of labour) or Intrapartum (after the onset of labour). The timing of foetal death was assigned by the status of foetal heart mentioned on referral documents or by history i.e., perception of foetal movements by mother before the onset of labour. In cases where mother was unable to comment or no documentation available, the appearance of foetus at time birth was used as a proxy as macerated for ante partum and fresh appearance for intrapartum stillbirths. The main cause of foetal death was further sub grouped, for antenatal five subgroups A1 to A5 whereas 11 for intrapartum I1 to I11. The maternal condition at the time of death was also assigned in to five sub groups (M1 to M5) (Table 3).

For example, A 22 years old primi gravida at 36 weeks of gestation was admitted with pre-eclampsia in spontaneous labour and delivered a stillborn of 1800 g. She also gave the history of absent foetal movements for the last 2–3 days and labour pains started on the day of admission. According to CODAC system, this stillbirth was attributed to Maternal condition with associated condition as perinatal (foetal growth retardation). But as per ICD PM Classification system it was an ante partum death, A5 (growth related) M4 (pre-eclampsia).

The demographical, clinical details and cause of death as per both COD-AC and ICD PM were entered on an EXCEL spreadsheet and descriptive analysis of data was done using SPSS.

Results

During study period there were a total of 5776 births and 314 stillbirths in the facility. The stillbirth rate was 54 per 1000 total births. Half of these stillbirths (49.6%) occurred at 28–34 weeks of gestation. The majority of stillbirths (58.2%) were fresh in appearance. The demographic characteristics are shown in Table 1.

Table 2 lists the causes of death according to CODAC which is the classification India had adopted for stillbirth surveillance. The largest category, 40.4%, was for maternal condition, 20.06% for placental causes and 10.5% were classified under unexplained. There were only 6 (1.9%) stillbirths attributed to intrapartum complications as most of the stillbirths were admitted with absent foetal heart sounds. Table 3 shows classification of 314 stillbirths according to ICD PM in which maternal condition was assigned for each case and where mothers were healthy grouped under M5. Out of 314 stillbirths, 69.1% were ante partum—i.e., foetus died before the onset of labour. In ante partum most common cause was A3 ante partum hypoxia (61.7%) and 20.2% were attributed to disorders related to foetal growth. Among intrapartum 49.4% of stillbirths were related to foetal growth disorders which

Table 1. Demographic and clinical characteristics of mothers and babies.

Total number of births	5776	Proportion (%)
Still birth	314	
Still birth rate	54 per 1000 total births	
Types of still birth	FSB = 183	58.2
	MSB = 131	41.7
Sex distribution	Male = 151	48.1
	Female = 159	50.6
	Ambiguous = 4	1.27
Age distribution	<35 years = 271	86.3
	≥35 years = 43	13.6
Parity	Para 0 = 132	42.0
	Para 1 = 85	27.1
	Para ≥2 = 97	30.9
Period of gestation	<28 weeks = 61	19.4
	28–34 weeks = 156	49.6
	>34 weeks = 97	30.9
Mode of delivery	Vaginal = 269	85.7
	Caesarean = 45	14.3
Birth weight of foetus	<1000 g = 117	37.3
	≥1000–2499 g = 153	48.7
	≥2500 g = 44	14.0

Table 2. Classification of stillbirth according to CODAC.

Cause of death	Total number of cases	Proportion
Infection	12	3.8
Hepatitis	6	
Syphilis	1	
Others	5	
Intrapartum	6	1.9
Malpresentation	2	
Prolonged/obstructed Labour	3	
Foetal distress	1	
Congenital anomaly	37	11.7
Foetal	31	9.87
Allo immunisation	5	
Hydrops of unknown origin	10	
Extreme prematurity	16	
Cord	5	1.59
Placenta	63	20.06
Abruption	56	
Placenta previa	7	
Maternal	127	40.44
Hypertensive disorder	70	
Diabetes	14	
Infection	1	
Others	42	
Unknown (Unknown/Unexplained)	33	10.50
Total	314	100
Associated Perinatal	27	
Small for gestation age	11	
Multiple Pregnancy	16	
Associated maternal	124	
Anemia	60	
Others	64	

Bold values are main groups and un-bold are sub groups.

include foetal growth retardation, small for gestational age fetuses and extreme prematurity. Overall ICD-PM Classification showed a smaller proportion of unexplained stillbirths (9 cases out of 314) compared to CODAC. On comparing both these classification systems, the actual proportion of intrapartum stillbirth were captured in ICD PM, whereas in CODAC, only intrapartum complications were captured.

Discussion

This analysis of a stillbirth cohort delivered in tertiary care hospital showed that the newer system of ICD-PM

classification was able to assign the cause for most of the stillbirths (96%) leaving only 4% unexplained. On the same data, the CODAC classification left 10.5% unexplained and unclassified. In resource poor countries the timing of death is the most important information which can be used to make international comparison and also planning interventions for prevention (Lawn et al. 2016). Whilst relying on skin appearance as a proxy for timing of stillbirth is necessary in many community based studies, it has been shown to be a poor proxy for classifying intrapartum and ante partum stillbirth (Gold et al. 2014). In this study 58% of all stillbirths were recorded to have a fresh skin appearance. Acting on these results would have prompted measures to improve intrapartum care to address these presumable intrapartum stillbirths. But according to ICD-PM classification system on the same data, 69.1% of the total Stillbirths were ante partum (death before the onset of labour) and only 30.9% intrapartum (death of the foetus after the onset of labour). With 69.1% of all stillbirths being ante partum, a focus on improving intrapartum care would not be expected to substantially reduce stillbirth rate; instead interventions would need to address pre-pregnancy health and antenatal care. ICD-PM classification provided some further advantages when compared to the CODAC system used in this facility in terms of using the data routinely collected to capture the real timing of perinatal death rather than relying on the skin appearance as a proxy. In CODAC only stillbirths due to intrapartum complications were captured and timing of stillbirth was not assigned at all.

ICD-PM for each stillbirth maternal condition has been assigned which is very important especially in cases where no foetal cause could be assigned as this might help in planning some interventions like optimising the existing disease and counselling of the mother. In CODAC system, 139 maternal conditions were assigned as the most probable cause for stillbirth and 63 were placental causes (ante partum hemorrhage), there were no details for the rest of 112 women. According to ICD-PM only 49 were healthy(M5), others were all classified in to M1: Complications of placenta, cord and membranes = 68, M2: Maternal complications of pregnancy = 40, M3: Other complications of labour and delivery = 18, M4: Maternal medical and surgical conditions = 139. Capturing both maternal and foetal events helped in understanding the perinatal death completely especially in a LMIC where availability of foetal detail is limited.

As per CODAC, 9.8% of stillbirths were classified under foetal cause which includes alloimmunization, hydrops of unknown origin and extreme prematurity whereas in ICD-PM system of classification each stillbirth is assigned to have a foetal cause either ante partum or intrapartum. Out of 217 ante partum stillbirths 14 (6.4%) were attributed to A1—congenital malformation, 134 (61.7%) A3—ante partum hypoxia, 16 (7.2%) A4—other specified ante partum disorders, 44 (20.2%) A5—disorders related to foetal growth, and only 9 (4.14%) were of A6—unspecified cause. Similarly, intrapartum stillbirths were also classified (Table 2).

On further going into the details of maternal conditions as per ICD PM in M1 subgroup (complications of placenta, cord and membranes), maximum cases were of abruption placenta.

Table 3. ICD PM classification system.

Maternal Condition	M1: complications of placenta, cord and membranes	M2: Maternal complications of pregnancy	M3: Other complications of labour and delivery	M4: maternal medical & surgical conditions	M5: no maternal conditions	Total	Proportion
Antepartum still births = 222	57	25	2	101	32	217	69.1
A1 Congenital malformation, deformation & chromosomal abnormalities	1	1	1	1	10	14	6.4
A2 infections	0	0	0	0	0	0	0
A3 Antepartum hypoxia	54	21	0	55	4	134	61.7
A4 Other specified antepartum disorders	0	0	1	7	8	16	7.4
A5 Disorders related to foetal growth	2	3	0	36	3	44	20.2
A6 Foetal death of unspecified cause	0	0	0	2	7	9	4.14
Intra partum still births = 92	11	15	16	38	17	97	30.9
I1 congenital malformations	1	1	0	6	14	22	22.6
I2 Birth trauma	0	0	0	0	0	0	0
I3 Acute intrapartum events	5	3	9	8	0	25	25.8
I4 Infections	0	0	0	0	0	0	0
I5 other specified intrapartum disorders	0	0	0	1	1	2	2.1
I6 Disorder related to foetal growth	5	11	7	23	2	48	49.4
I7 Intrapartum death of unspecified cause	0	0	0	0	0	0	0
Total	68	40	18	139	49	314	

Bold values are main groups and un-bold are sub groups.

Almost 85% of them were ante partum stillbirths and only 15% intrapartum. By CODAC we could capture the cause of stillbirth as abruptio but not the time of death (ante partum or intrapartum). Time of foetal death would help in assessing the accessibility, approachability and quality of available health care services in any particular region. Therefore, such a large proportion of ante partum stillbirths due to abruptio indicate the need to improve health care facilities and strengthening referral systems so that these women could have reached health care facilities with live foetuses.

There were only 18 cases i.e., 5.73% of all still births which were attributed to M3-labour and delivery related complications, out of which 2 were categorised as ante partum as one case was of birth defect with rupture uterus and another was a case of non-immune hydrops with preterm labour. Among intrapartum one was attributed to complication of instrumental delivery, 7 rupture uteri, 1 obstructed labour and 7 were with pre-term labour. In CODAC foetal deaths attributed to prematurity were picked under foetal condition whereas cases of foetal growth retardation were captured as associated conditions. In ICD-PM these cases were grouped as ante partum under A5 and intrapartum in A6. With ICD-PM Classification we could find out that there were 48 intrapartum stillbirths attributed to foetal growth which include foetuses of <1000 grams (severe foetal growth retardation/prematurity) and most of them were alive when they reached health care facility. They all were not saved due to very low birth weight, non-availability of NICU at that time or refusal by parents for neonatal care outside due to financial constraints. Whereas in CODAC these were grouped as prematurity under foetal causes, foetal growth retardation under associated perinatal conditions.

In both of these classification systems maternal conditions were assigned for the cause of death and Hypertensive disorder of pregnancy (HDP) was the leading contributory cause. According to ICD PM 54.6% (76) of still births were due to HDP, among which 51 (67%) were ante partum and rest intra partum. The common causes of foetal death were disorders related to foetal growth and ante partum hypoxia. There

were a significant number of intra partum stillbirths in this group and causes were very low birth weight, severe IUGR, non-availability of NICU care, Non-affordability for neonatal care by family and refusal for caesarean for foetal indication.

There were only 9(2.8%) cases in which cause of stillbirth was not assigned and categorised under A6—foetal death of unspecified cause. Among them, 7 mothers were absolutely healthy with no underlying medico surgical disorder or any pregnancy associated complication. Rest two were classified under M4, were absolutely healthy with no active disease. In CODAC 10.5% of cases were classified as unknown/unexplained.

Strength and limitation

This is the first study where same cohort of stillbirths of a low middle-income country was classified using both COD-AC and ICD-PM system of classification and compared. With ICD-PM application, all these stillbirths were categorised more clearly in different groups and linking each with both intrapartum and ante partum stillbirth which can help to set the priorities and future planning. It also seems to facilitate the consistent collection of stillbirth data globally as well. But application of ICD- PM was challenging in our setup where majority of the women reach health care facility after intra-uterine death of the foetus with limited antenatal investigations available. In most of the cases there was no direct evidence of foetal activity available as most of them did not have any contact with health care provider or ultrasonography before intrauterine foetal demise. The timing of stillbirth was assigned according to the history given by the mother about the perception of foetal movement in relation to labour pains. In a latest study by Aminu et al., they have created an additional category as unknown timing of death along with ante partum and intrapartum (Aminu et al. 2019). The exact pathogenesis of majority (61.7%) of ante partum stillbirth were not clearly known, and grouped under A3-ante partum hypoxia without histological evidence of autopsy or

placental examination . There were limitations like incomplete work up, non-availability of infections screen, previous records and the most probable clinical cause was assigned as a cause for both the system of classifications.

Conclusion

The ICD-PM and CODAC classification both seem to be feasible in our setup. Although CODAC also captured the associated maternal and foetal conditions, ICD-PM clearly defined the time of stillbirth i.e., ante partum or intrapartum and correlated fetomaternal dyad together. The proportion of unexplained stillbirth was significantly reduced by classifying stillbirths according to ICD-PM compared to CODAC. However, there are inherent challenges especially in LMICs like logistics and system failures which cannot be captured by any classification available. These can only be picked up by perinatal death reviews, taking history in detail and addressing the modifiable factors along with the level of delays.

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This data was collected in the department of obstetrics & gynecology of PGIMER, same data was also submitted to WHO.

Ethical approval

Ethical approval was obtained on 18.02.2014 from *Institutional ethics committee, Postgraduate institute of medical education and research, Chandigarh*, PGI/IEC/2014/2220.

Disclosure statement

The authors declare that there is no financial or non-financial conflict of interest.

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