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ORIGINAL ARTICLE

Proposing a Hybrid Model Based on Robson's Classification for Better Impact on Trends of Cesarean Deliveries

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Abstract

Aim and Objectives To construct a hybrid model classification for cesarean section (CS) deliveries based on the woman-characteristics (Robson's classification with additional layers of indications for CS, keeping in view low-resource settings available in India).

Methods This is a cross-sectional study conducted at Nalanda Medical College, Patna. All the women delivered from January 2016 to May 2016 in the labor ward were included. Results obtained were compared with the values obtained for India, from secondary analysis of WHO multi-country survey (2010–2011) by Joshua Vogel and colleagues' study published in "The Lancet Global Health." The three classifications (indication-based, Robson's and hybrid model) applied for categorization of the cesarean

deliveries from the same sample of data and a semiqualitative evaluations done, considering the main characteristics, strengths and weaknesses of each classification system.

Results The total number of women delivered during study period was 1462, out of which CS deliveries were 471. Overall, CS rate calculated for NMCH, hospital in this specified period, was 32.21% ($p = 0.001$). Hybrid model scored 23/23, and scores of Robson classification and indication-based classification were 21/23 and 10/23, respectively.

Limitations of the Study Single-study centre and referral bias are the limitations of the study.

Conclusion Given the flexibility of the classifications, we constructed a hybrid model based on the woman-characteristics system with additional layers of other classification. Indication-based classification answers why, Robson classification answers on whom, while through our hybrid model we get to know why and on whom cesarean deliveries are being performed.

Keywords Cesarean section · Robson classification · Hybrid model

Introduction

Over the last 20 years, there has been a disturbing trend of increased cesarean section (CS) rates in India. In a population-based cross-sectional study of an urban area of India done by Sreevidya S and Sathiyasekaran BWC in the year 2013, the total CS rates even in the public and charitable sectors were 20 and 38%, respectively, while in private sectors, the rate was an unbelievable 47%. According to World Health Organization (WHO) in 1985 in Fortaleza, Brazil, "There is no justification for any region to have a rate higher than 10–15%." This was revised in 1994 and 1997 by UNICEF, WHO and UNFPA stating that proportion of cesarean births should range between 5 and 15%. The rate of CS below 5% seems to be associated with gaps in obstetric care leading to poor health outcomes, whereas rates over 15% do not seem to improve either maternal or infant health. Cost is also a major factor in improving equitable access to maternal and newborn care, as CS represents a significant expense for overloaded—and often weakened—health systems. The determinants of this increase, especially in low-income and middle-income countries, are controversial. India has yet to establish guidelines for acceptable CS rates and classification. In order to propose and implement effective measures to reduce or increase CS rates where necessary, it is first essential to identify what groups of women are undergoing CS and investigate the underlying reasons for trends in different settings. This requires the use of a classification system that can best monitor and compare CS rates in a standardized, reliable, consistent and action-oriented manner.

In 2014, WHO recommended that "regardless of their level of complexity, healthcare facilities should use the Robson's ten group classification system for women admitted to give birth" [1]. Users report that the *basic* Robson classification identifies the contributors to the CS rate but does not provide insight into the reasons (indications) or explanations for the differences observed [2].

On the other hand, the most common traditional classification—indication-based also, has many short comings.

Our study is an effort for construction of a hybrid model classification to overcome the deficiencies of Robson's and indication-based classification, for yielding better results even in low-resource settings.

Aim and Objectives

1. To construct a hybrid model based on the woman-characteristics with additional layers of indications for CS, keeping in view low-resource settings available in India.
2. To analyze qualitatively and compare the advantages and deficiencies of women-based and indication-based classifications.
3. To determine incidence, trends and contributors of CS in a tertiary care hospital in a developing country.

Methods

This is a cross-sectional study, conducted at Nalanda Medical College, Patna. All the women delivered from January 2016 to May 2016 in the labor ward were included. All relevant obstetric information (parity, mode of previous deliveries, previous CS and indications, gestational age, onset of labor, spontaneous or induced labor) was entered on Microsoft excel. Results were calculated at the end of this period. Results obtained were compared with the values obtained for India, from secondary analysis of WHO Multi-country Survey (2010–2011) by Joshua Vogel and colleagues' study in "The Lancet Global Health" [3], and p values were calculated by using Chi-square test. Before proceeding, approval was sought from hospital ethical and research committee.

The three classifications (indication-based, Robson's and hybrid model) applied for categorization of the cesarean deliveries from the same sample of data and a semiqualitative evaluations done, considering the main characteristics, strengths and weaknesses of each classification system. Seven specific domains (ease of use, clarity,

exclusiveness of categories, inclusiveness of classification, possibility of using classification prospectively, reproducibility and requirements for implementation) [4] and three other characteristics were graded (2 = good; 1 = medium; 0 = poor). The final grade of each classification ranged from 10 to 23, the higher the grading the better the classification. Classifications were compared by the percentage of cases made reproducible, mutually exclusive and totally exclusive by each of classifications.

Results

The total number of women delivered during study period was 1462, out of which CS deliveries were 471. Overall, CS rate calculated for NMCH, hospital in this specified period, was 32.21% ($p = 0.001$).

Table 1 shows results of indication-based classifications (some percentages in this table do not add up to 100% because of rounding errors).

Results from this classification showed scarred uterus with 45.8% as the most frequent indication for cesarean deliveries followed by fetal distress (21.4%), NPOL (non-progress of labor) (9.1%) and breech (6.4%). Out of 471 cases 377 were classified as 82 cases were having more than one indications, and 12 cases were not having proper data.

Table 2 shows results of Robson's classification (some percentages in this table do not add up to 100% because of rounding errors).

Results for Robson's classification showed that largest contribution for overall deliveries was from Group 3 with size 36% and overall cesarean rate contribution 1.43% ($p = 0.4006$). Group 5 contribution was largest for overall cesarean rate 14.8% ($p = 0.0001$), followed by Group 1 contribution 8.27% ($p = 0.0218$). Group 6 and 7 included all breech presentations 4.7% of overall deliveries. Group X comprises of all the deliveries with missing data 4.1% with overall cesarean rate 0.8% ($p = 0.77$).

Table 3 shows analysis of cesarean trends by hybrid model (some percentages in this table do not add up to 100% because of rounding errors).

Results from hybrid model showed most frequent indication for CS in Group 5 was scar tenderness 58.06%, while in Group 1 most frequent indication was fetal distress 41.3%, followed by NPOL 26.4%. Overall incidence of Prev CS after excluding missing data was [(217 + 7 + 3)/1402] 15.5%. Overall incidence among total cesarean deliveries (after excluding missing data) of Prev CS was [(217 + 7 + 3)/459] 47.4%, fetal distress [(50 + 7 + 5 + 14 + 3 + 4)/459] 18.1%, of NPOL [(32 + 7 + 6)/459] 9.8%, obstructed labor [(11 + 7)/459] 3.9%, CPD (cephalopelvic disproportion) [14/459] 3.0%, antepartum hemorrhage(APH) [(3 + 6 + 13)/459] 4.7% and pregnancy induced hypertension(PIH)/eclampsia [(10 + 5 + 6 + 4)/459] 5.4%.

Table 1 Indications for CS

Indications	No. of cases classified ($n = 377$)	Percentages
Prev 1 CS with scar tenderness	126	33.4 (126/377)
Prev 2 CS	47	12.4 (47/377)
Fetal distress	81	21.4 (81/377)
NPOL (non-progress of labor)	33	9.1 (33/361)
Breech	24	6.4 (24/377)
PIH (pregnancy induced hypertension) + eclampsia	12	3.1 (12/377)
Obstructed labor	13	3.4 (13/377)
Severe oligohydramnios/IUGR	10	2.7 (10/377)
CPD (cephalopelvic disproportion)	12	3.1 (12/377)
APH (ante partum hemorrhage)	10	2.7 (10/377)
Multiple pregnancies	3	0.8 (3/377)
Abnormal lies + compound presentations	3	0.8 (3/377)
Congenital anomalies (hydrocephalus)	3	0.8 (3/377)
Cases not classified ($n = 94$)		
More than one indication	82	
Missing data	12	
Total	471	

Categories with less clarity: fetal distress, NPOL, CPD and obstructed labor (due to absence of clear, precise and unambiguous classifications)

Cases without mutual exclusiveness: cases with missing data and cases with more than one indication

Cases without total inclusiveness: cases with missing data and with more than one indication

Categories not prospectively identifiable: categories with less clarity

Cases not prospectively identifiable: cases with more than one indication, cases with missing data and cases in categories with less clarity

Table 4 shows hybrid model scored 23/23, Robson classification 21/23 and indication-based classification 10/23.

Limitations of the Study

- Single-study centre.
- Referral bias.

Discussion

In the present study, incidence of cesarean is about 32.21% in accordance with Joshua Vogel and colleagues' study in *The Lancet Global Health (international cesarean rate: 31.2%), but* much higher then the WHO recommended

Table 2 Robsons classification

Robson 's ten group classification	No. of CS over total no. of women in each group	Relative size of group (%)	CS rate in each group (%)	Contribution made by each group to overall CS rate (%)	*p* value
1. Nulliparous, single cephalic, >37 weeks in spontaneous labor	121	(443/1462) 30.3	(121/443) 27.3	(121/1462) 8.27	0.0218
2. Nulliparous, single cephalic, >37 weeks, induced or CS before labor	21	(54/1462) 3.69	(21/54) 38.9	(21/1462) 1.43	0.1408
3. Multiparous (excluding previous CS), single cephalic, >37 weeks in spontaneous labor	21	(526/1462) 36	(21/526) 4	(21/1462) 1.43	0.4006
4. Multiparous (excluding prev CS), single cephalic >37 weeks, induced or CS before labor	8	(20/1462) 1.37	(8/20) 40	(8/1462) 0.55	0.15
5. Previous CS, single cephalic, >37 weeks	217	(236/1462) 16.1	(217/236) 92	(217/1462) 14.8	0.0001
6. All nulliparous breeches	27	(34/1462) 2.3	(27/34) 79.4	(27/1462) 1.84	0.39
7. All multiparous breeches (including previous CS)	21	(36/1462) 2.4	(21/36) 58.3	(21/1462) 1.4	0.38
8. All multiple pregnancies (including previous CS)	3	(9/1462) 0.62	(3/9) 33.3	(3/1462) 0.21	0.17
9. All abnormal lies (including previous CS)	3	(3/1462) 0.20	(3/3) 100	(3/1462) 0.21	0.3
10. All single cephalic, <36 weeks (including previous CS)	17	(41/1462) 2.8	(17/41) 41.5	(17/1462) 1.2	0.02
X. Deliveries with missing data	12	(60/1462) 4.1	(12/60) 20	(12/1462) 0.8	0.77
Total	471	100		32.14	

Categories with less clarity: zero

Cases without mutual exclusiveness: zero

Cases without total inclusiveness: zero

Categories not prospectively identifiable: categories with missing data

Cases not prospectively identifiable: cases with missing data

rate. Rising incidence can be explained by the fact that a tertiary care hospital receives a good number of high-risk emergency cases with inadequate or no antenatal care. Most of the patients reaching tertiary centre are brought late in labor after being handled by untrained birth attendants and are actually and potentially infected, often anemic and dehydrated. Nowadays, early detection and early decision also increase the incidence of CS.

In all the classifications, major contributor for CS was the previous CS category (Group 5 in Robson and hybrid model) in accordance with Saha et al. [5] study in 2008, Kazmi et al. [6] study in 2012, Joshua Vogel and colleagues' study in *The Lancet Global Health* [3].

Similar to other studies [3, 5], the CS rate in breech pregnancies was high (>68%) in our study. To reduce the rate associated with breech delivery, an active policy of external cephalic version at term may be considered, and secondly, cesarean breech deliveries may be delayed to allow time for spontaneous version to take place [7].

A small group of women which could not be classified because of inconsistencies or missing values in Robson criteria allows for assessment of quality of the data and validity of the interpretation [7].

Classifications based on **indications for CS** are the most frequent type used till now [4]. The main question answered by this type of classification is "why" the CS was being performed. Main weaknesses of these systems include: (a) poor/unclear definitions for some of the most common conditions that lead to CS (e.g., dystocia, fetal distress) and therefore questionable reproducibility; (b) categories not mutually exclusive; (c) not being totally inclusive, unless an extensive list of indications is provided or an "other indications" category is created; and (d) not very useful to change clinical practice, as most of the indications are not prospectively identifiable [4].

Classifications based on **woman-characteristics (i.e. Robson's classification)** basically tell us "who" is being submitted to CS, based on maternal and pregnancy characteristics. These classifications are conceptually easy and simple, have clearly defined categories which are mutually exclusive and allow cases to be prospectively identified upon admission, which could be useful to change clinical practice.

Using the Robson criteria can inform efforts to manage cesarean section rates at both the individual facility and national level by identifying how structure of obstetric populations and

Table 3 Hybrid model classification

Robson's ten group classification	CS rate in each group (%)	Contribution made by each group to overall CS rate (%)	Age group with highest cesarean rate (years)	Indications in each group		
1	(121/443) 27.3	(121/1462) 8.27	20–25	Fetal distress	50/121	41.3%
				NPOL	32/121	26.4%
				CPD	14/121	11.6%
				Obstructed labor	11/121	9.09%
				Severe oligohydramnios	14/121	11.6%
2	(21/54) 38.9	(21/1462) 1.43	20–25	PIH/eclampsia	10/21	47.6%
				Postdated + fetal distress	7/21	33.3%
				Failed induction	4/21	19%
3	(21/526) 4	(21/1462) 1.43	25–30	Obstructed labor	7/21	33.3%
				NPOL	7/21	33.3%
				Fetal distress	5/21	24%
				Failed induction	2/21	9.5%
4	(8/20) 40	(8/1462) 0.55	25–30	PIH/eclampsia	5/8	62.5%
				APH	3/8	37.5%
5	(217/236) 92	(217/1462) 14.8	25–30	Scar tenderness	126/217	58.06%
				Prev 2 CS	47/217	21.2%
				Fetal distress	14/217	6.45%
				PROM	12/217	5.52%
				NPOL	6/217	2.7%
				Placenta previa	6/217	2.7%
				PIH/eclampsia	6/217	2.7%
6	(27/34) 79.4	(27/1462) 1.84	19–24	Fetal distress	3/27	11.1%
				Apprehension for breech	24/27	89%
7	(21/36) 58.3	(21/1462) 1.4	20–25	Prev lscs with scar tenderness	7/21	33.3%
				Apprehension for breech	7/21	33.3%
				Fetal distress	4/21	19.04%
				Severe oligohydramnios	3/21	14.2%
8	(3/9) 33.3	(3/1462) 0.21	20–25	Unfavorable presentation	3/3	100%
9	(3/3) 100	(3/1462) 0.21	20–25			
10	(17/41) 41.5	(17/1462) 1.2	25–30	PIH/eclampsia	4/17	24%
				APH (including 3 prev 2 CS)	13/17	76.5%
X	(12/60) 20	(12/1462) 0.8				

Categories with less clarity: zero

Cases without mutual exclusiveness: zero

Cases without total inclusiveness: zero

Categories not prospectively identifiable: categories with missing data

Cases not prospectively identifiable: cases with missing data

intervention rates change with time [4]. It identify contributors to differences in CS rates across subgroups, but does not provide an explanation for these differences, nor look at the specific reason for performing the CS, while the hybrid model overcomes this limitation as it analyses maternal age and classifies the subgroups by indications also.

Many users have recommended for analysis of pre-pregnancy body mass index and medical disorders in Robson's classification, but in a developing country where only a few number of women turn up for antenatal checkups, this may not be useful and will also lower the implementability.

Table 4 Comparision of the three classifications

Domains	Robson classification	Indication-based classification	Hybrid classification
Easy[1]	Good (Grade-2)	Good (Grade-2)	Good (Grade-2)
No. of categories with clarity[2]	(11/11) 100% (Grade-2)	(9/13) 69% (Grade-0)	(11/11) 100% (Grade-2)
No. of cases mutually exclusive[3]	(471/471) 100% (Grade-2)	(377/471) 80% (Grade-1)	(471/471) 100% (Grade-2)
No. of cases totally inclusive[4]	(471/471) 100% (Grade-2)	(377/471) 80% (Grade-1)	(471/471) 100% (Grade-2)
Prospective identification of categories at admission[5]	(10/11) 91% (Grade-2)	(9/13) 69% (Grade-0)	(10/11) 91% (Grade-2)
No. of cases prospectively categorized	(459/471) 97.4% (Grade-2)	(238/471) 50.5% (Grade-0)	(459/471) 97.4% (Grade-2)
No. of cases reproducibile[6]	(471/471) 100% (Grade-2)	(389/471) 82.5% (Grade-1)	(471/471) 100% (Grade-2)
Implementability[7]	Good (Grade-2)	Good (Grade-2)	Good (Grade-2)
No. of cases classified[8]	(471/471) 100% (Grade-2)	(377/471) 80% (Grade-1)	(471/471) 100% (Grade-2)
Questions explained	On whom cesarean performed (Grade-2)	Why cesarean performed (Grade-2)	On whom and why cesarean performed (Grade-4)
Guidance for missing data[10]	Present (Grade-1)	Absent (Grade-0)	Present (Grade-1)
Total score	21	10	23

[1] Easy: how much effort or time it takes to understand main concepts, logic and rules of the classification. Grades: 2 = good, 1 = medium, 0 = poor

[2] Clarity: clear, objective, precise and unambiguous definitions given for each category. Grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[3] Mutually exclusive: each unit being classified by the system (e.g., woman or CS) can only be placed in a single of the existing categories. Grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[4] Totally inclusive: each and every unit being classified can be placed in at least one of the categories. Grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[5] Prospective identification of categories: allows classification of the patient into one of the categories at time of admission. Grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[6] Reproducibility: probability that the same case would be classified in the same category by different raters. Grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[7] Implementability: human and material requirements needed to introduce and maintain the classification in continuous use. Grades: 2 = good, 1 = medium, 0 = poor

[8] No. of cases classified-grades: (100–90%) = 2, (90–80%) = 1, (<80%) = 0

[9] Questions explained, gradings: (one question) = 2, (two question) = 4

[10] Guidance for missing data, gradings: present = 1, absent = 0

Conclusion

Given the flexibility of the classifications, we constructed a hybrid model based on the woman-characteristics system with additional layers of other classification. Indication-based classification answers why, Robson classification answers on whom, while through our hybrid model we get to know why and on whom cesarean deliveries are being performed.

With a clear understanding of why and on whom CS are being performed, it would then be possible to propose and implement effective strategies and actions specifically targeted at high-risk groups that will possibly reduce or increase the rate of CS in order to continue improving maternal and perinatal outcomes. Moreover, hybrid model is a symbolic presentation of collaborative effort of clinician and public health person as clinicians are particularly interested in indications for CS, while Robson's classification fascinates public health person. For a better health impact on society, hybrid model when applied on large population may emerge as winner among the two classifications in long term.

Compliance with Ethical Standards

Conflict of interest Dr. Punit Hans and Dr. Renu Rohatgi declare that they have no conflict of interest.

Ethical statement This study was approved by institutional ethical committee. Consent was not needed as this was an observational study and none of the patient particulars or identifications was disclosed.

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