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Original article

Introduction of newer strategies for the highest implementation of delayed umbilical cord clamping after caesarean birth – A quality improvement study

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Abstract

Introduction: Delayed cord clamping (DCC) is a cost-effective delivery room intervention for better neonatal outcome. The study objective was to implement the standard practice of DCC in at least 80% of eligible neonates born by caesarean section (CS) within 2 months through multiple Plan-Do-Study-Act (PDSA) cycles.

Methods: All vigorous neonates born through CS were eligible for clamping of cord ≥ 30 seconds (DCC) after birth except neonates with Rh isoimmunisation, congenital malformations, intra-uterine growth restricted fetuses with abnormal Doppler, placenta previa, abruptio placentae, cord avulsion and monochorionic-monoamniotic twins. Baseline practice of DCC in CS was observed and possible barriers elicited by fishbone analysis. Quality improvement (QI) team implemented various strategies (scientific knowledge dissemination, pre-operative planning for DCC, preventive measures for hypothermia in preterms, "cord clamp clock" in operation theatre, etc.) through a series of PDSA cycles. Timing of cord clamping (CC) was noted by a dedicated staff nurse with stopwatch.

Result: Out of 112 caesarean deliveries conducted during the implementation phase, 48 and 36 deliveries were eligible for DCC during the first (PDSA-1) and the second (PDSA-2) cycle, respectively. During PDSA-1, DCC rate increased from baseline of 20% to 77% which further improved to 83.3% in PDSA-2 and 100% in the sustenance phase. The mean (SD) duration of CC during baseline, PDSA-1, PDSA-2 and sustenance phase were 13.7 (± 9.3), 30 (± 9.4), 35.2 (± 14.2), 46.6 (± 13.9) seconds, respectively.

Conclusion: Implementation of best practice of DCC is challenging and needs multidisciplinary approach. Maintaining high compliance rate of DCC demands boosting confidence among perinatal team members and continued evaluation at regular intervals.

Keywords

Delayed cord clamping, caesarean section, neonates, placental transfusion, resuscitation.

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Introduction

Delayed cord clamping (DCC), defined as clamping of cord for ≥ 30 seconds after delivery, is the umbilical cord management strategy during neonatal transitional period which aims to facilitate continued placental transfusion after delivery [1]. The infant receives around 25% to 60% extra blood volume from its own preserved fetal blood in the placenta [2]. For term infants, it offers the advantage of greater iron stores and hence decreases the incidence of iron deficiency anaemia in the long term, a major concern in low- and middle-income countries [3-5]. DCC has proven benefits in preterm neonates by decreasing the risk of intracranial bleed, necrotising enterocolitis, need of blood transfusion with improvement in haematocrit and better hemodynamic stabilisation [4, 6]. In a recently published systematic review, a 32% reduction in neonatal mortality with DCC in preterm babies has been documented [7]. American College of Obstetricians and Gynaecologists (ACOG) recommends (2020) a delay in umbilical cord clamping (CC) in vigorous term and preterm infants for at least 30-60 seconds after birth, which has also been endorsed by American Academy of Paediatrics [8, 9].

Though the practice of DCC has become the standard guideline across the globe, it is seldom practised in those born by caesarean section (CS), which are mostly conducted in emergency settings involving high risk pregnancies. The traditional practice of earliest handing over the neonates to paediatrician with immediate CC for neonatal resuscitation is still followed at large in high risk cases. The practice of DCC needs a coordinated multidisciplinary approach where stakeholders are obstetricians, paediatricians and nursing staffs participating in CS. In an observation made over the second fortnight of December 2020 in our tertiary care teaching hospital, 15 out of 28 deliveries were caesarean birth and 3 of 15 (20%) neonates got benefit of DCC, with average timing of CC being 13.7 ± 9.3 seconds. So in this context, to minimise the gap between knowledge and practice and for better neonatal benefit, a quality improvement (QI) initiative was taken up to implement DCC in all eligible neonates born through CS with multiple Plan-Do-Study-Act (PDSA) cycles.

Methodology

This QI project was undertaken in a tertiary care hospital of Odisha, India, during the period from January 2021 to March 2021, after the approval of the institutional Research and Ethics Committee. As DCC is a part of standardised patient care, individual patient consent is not required. Baseline rate of DCC practised in our institute during the last fortnight of December 2020 was documented by two individual authors. A QI team comprising of pediatricians, obstetricians and nurses working in the operation theatre (OT) was formed with the aim of implementing the standard practice of DCC (for at least 30 seconds) in at least 80% of caesarean birth within 8 weeks. All neonates born by CS were included in this study excluding those who were non-vigorous at birth, intra-uterine growth restricted babies with abnormal Doppler findings, antenatally diagnosed Rh isoimmunisation cases, monochorionic-monoamniotic twins, placenta previa, abruptio placentae, cord avulsion and neonates with congenital malformations. Baseline maternal and neonatal characteristics, along with the duration of delay in CC, were duly noted in the predesigned proforma. The state of neonate at birth was assessed by presence of spontaneous breathing effort and gestational age appropriate muscle tone. Neonatal vigorous state was labelled by the obstetrician conducting CS and decision supported by the attending pediatrician present in OT for neonatal resuscitation as well as the nursing staff. The interval between complete extraction of baby out from uterus to timing of CC was noted with the help of a stop watch by a dedicated nursing staff, who was not assigned any other job during cesarean delivery. All the possible reasons behind the non-practice of DCC were elicited by fishbone analysis (**Fig. 1**) and key drivers were developed to achieve the study aim (**Fig. 2**) for which the team met every four weekly. The ideas generated were tested through a series of

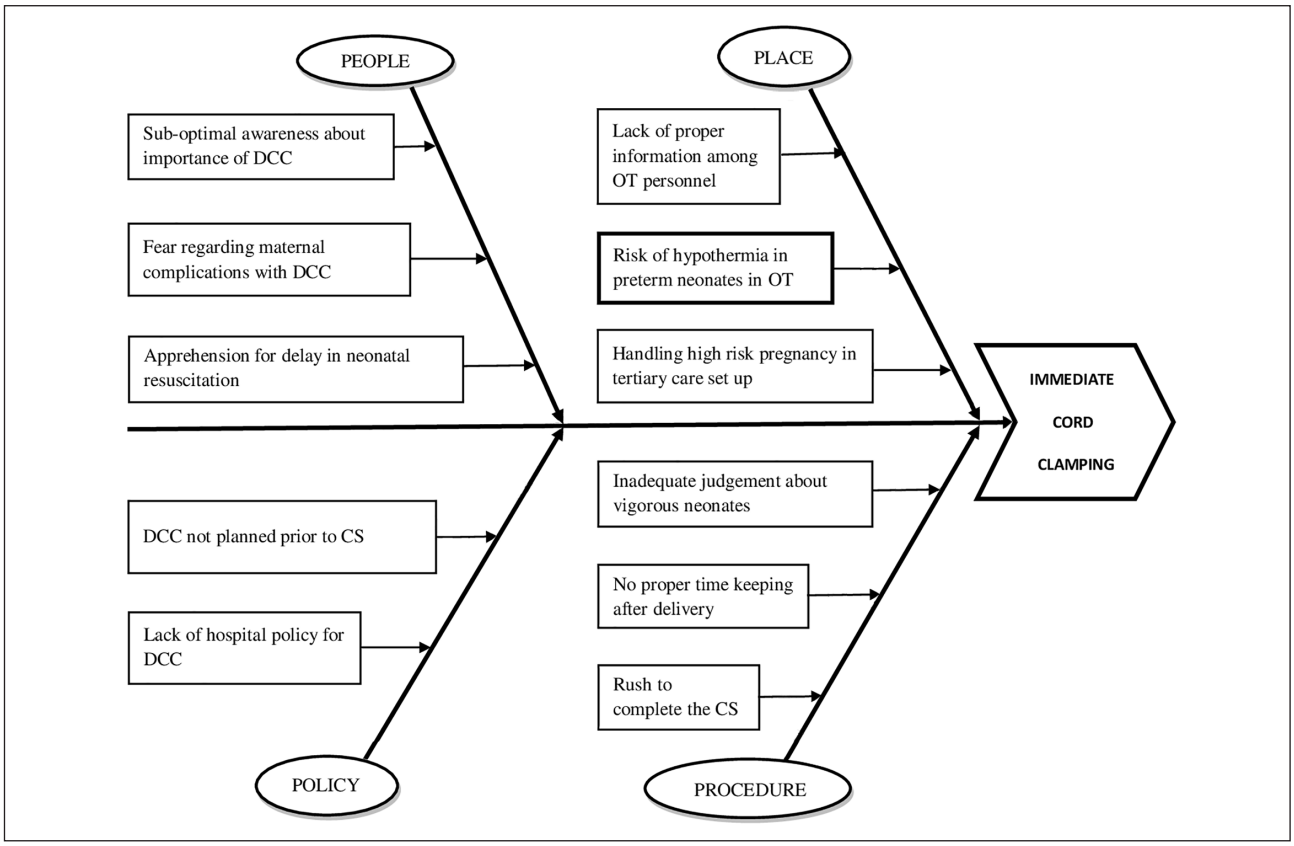

Figure 1. Fishbone analysis (root cause analysis) of various factors leading to the practice of early cord clamping.
CS: caesarean section; DCC: delayed cord clamping; OT: operation theatre.

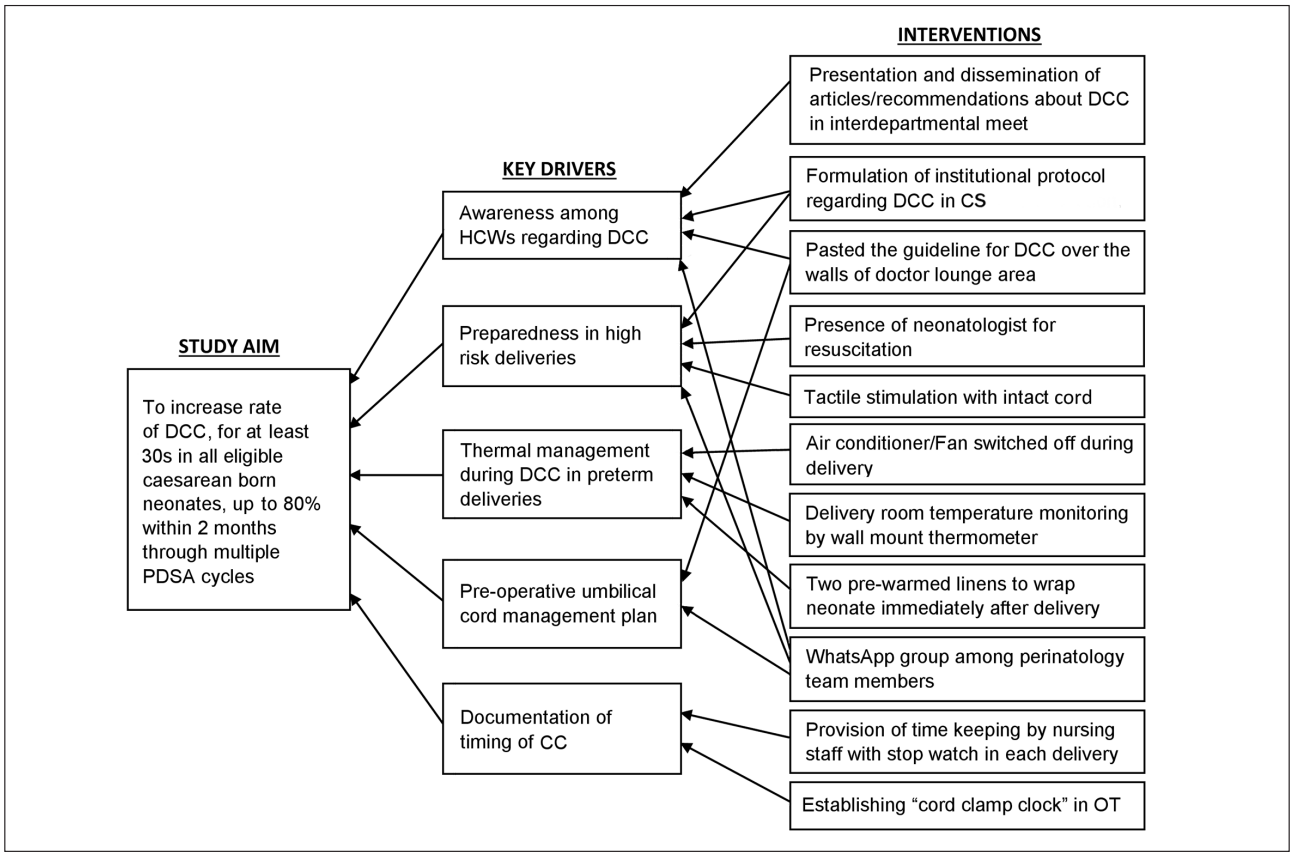

Figure 2. Key driver diagram.
CS: caesarean section; DCC: delayed cord clamping; HCWs: health care workers; OT: operation theatre; PDSA: Plan-Do-Study-Act.

PDSA cycles – first (PDSA-1) and second (PDSA-2) PDSA cycles (**Tab. 1**). The effect of change in ideas was assessed by recording the proportion of DCC done in eligible neonates. It was planned that the team will continue to monitor the DCC rates for sustenance over the next month every fortnightly, after attaining the target, and any fall more than 10% in DCC to be evaluated with further PDSA cycles.

The maternal and neonatal characteristics were documented in Excel® sheet. Statistical analysis was performed using SPSS® version 20.0 (SPSS Inc., Chicago, IL, USA). The maternal and neonatal characteristics were represented by mean ± standard deviation (SD), number and frequency. The comparison of neonatal and maternal characteristics at baseline phase and PDSA-1 and PDSA-2 phases were analysed by Anova and p-value of < 0.05 was considered as statistically significant; p-chart was used to display the progress of DCC over time.

Result

A total of 112 caesarean deliveries were conducted during the study period of 2 months, out of which 28 were excluded from the study. Total 48 and 36 caesarean deliveries were eligible for the

Table 1. Summary of strategies implemented by quality improvement (QI) team through Plan-Do-Study-Act (PDSA) cycles.

Phases	Plan	Do	Study	Act
PDSA-1	1. Awareness of DCC among obstetricians, anaesthetists, neonatologists/ paediatricians, nurses about the standard recommendation of CC. 2. Educating about the benefits of DCC both in term and preterm babies. 3. Documentation of timing of CC after each delivery. 4. Precaution for prevention of hypothermia during DCC in preterm delivery.	1. Presentation about DCC in interdepartmental meet. 2. Dissemination of published articles, Neonatal resuscitation programme-2015 recommendation about DCC among perinatology team. 3. Formulation of institutional protocol regarding DCC in CS. 4. Reassurance of presence of a neonatologist for neonatal resuscitation. 5. Provision of time keeping by nursing staff with stop watch in each delivery. 6. Two pre-warmed linens used to wrap the neonate immediately after delivery.	1. Rate of DCC from 20% to 77%. 2. Duration of CC increased from 13.7 seconds to 30 seconds. 3. DCC ≥ 60 seconds achieved in 2 deliveries.	1. Increase the confidence among obstetricians to practice DCC. 2. Motivate senior faculties to discuss frequently about DCC among team members. 3. Extend the benefit of DCC in subsequent deliveries.
PDSA-2	1. To further increase the practice of DCC to attain the target. 2. To increase the duration of CC in vigorous neonates.	1. Neonatologist took the responsibility to initiate plan about DCC prior to CS. 2. Pasted the guideline for DCC over the walls of doctor lounge area. 3. Display the success story of first PDSA in graphical chart in OT. 4. Tactile stimulation of neonate with intact cord in clear amniotic fluid condition. 5. WhatsApp group among perinatology team to disseminate the status of neonate after success of DCC. 6. Establishing “cord clamp clock” in OT.	1. Rate of DCC from 77% to 83.3%. 2. Average duration of CC increased from 30 seconds to 35.2 seconds. 3. DCC ≥ 60 seconds achieved in 6 deliveries.	1. Continuing the success of implementing DCC. 2. Periodic review of the practice by a senior team member. 3. Incorporating as an important step in neonatal resuscitation even in high-risk deliveries.

CC: cord clamping, CS: caesarean section; DCC: delayed cord clamping; OT: operation theatre; PDSA: Plan-Do-Study-Act; PDSA-1: first PDSA cycle; PDSA-2: second PDSA cycle.

practice of DCC during PDSA-1 and PDSA-2 cycle, respectively. Indications of CS in DCC eligible cases were foetal distress (57 [67.9%]), previous CS (20 [23.8%]) and parental wish (7 [8.3%]) during the implementation phase.

The maternal and neonatal characteristics were comparable in the baseline, PDSA-1 and PDSA-2 phases of the study (**Tab. 2**).

In the baseline phase, DCC was practised in only 3 out of 15 (20%) CS, the mean (SD) duration of CC was 13.7 (± 9.3) seconds. During PDSA-1, the DCC rate increased from 20% to 77%, the mean duration of CC was 30 (± 9.4) seconds; and in 2 (4.2%) out of 48 caesarean cases CC was delayed for ≥ 60 seconds. During PDSA-2, DCC rate further improved to 83.3%, mean duration of CC was 35.2 (± 14.2) seconds; and in 6 (16.7%) out of 36 cases CC was delayed for ≥ 60 seconds.

In the sustenance phase, DCC was observed to be practised in all the eligible neonates born by CS (100% DCC rate). During this phase, in 21 (48.8%) out of the 43 caesarean cases CC was delayed for ≥ 60 seconds, with average duration of CC being 46.6 (± 13.9) seconds.

The comparison in progression of DCC rate from baseline period, PDSA-1, PDSA-2 till sustenance phase are represented in the control (p) chart (**Fig. 3**).

Table 2. Comparison of maternal and neonatal characteristics before the quality improvement (QI) study, during the first Plan-Do-Study-Act (PDSA) cycle (PDSA-1) and the second PDSA cycle (PDSA-2).

Parameters	Before QI study (n = 15)	During PDSA-1 (n = 48)	During PDSA-2 (n = 36)	p-value
Maternal age (years)	29.00 ± 4.78 (21-38)	28.52 ± 3.88 (19-35)	30.3 ± 3.94 (24-37)	0.13
Gestational age (weeks)	37.12 ± 2.37 (32^{+6}-40)	38.07 ± 1.15 (35^{+2}-40^{+5})	37.48 ± 1.57 (34^{+4}-40^{+2})	0.06
Birth weight (kg)	2.81 ± 0.73 (1.6-3.85)	2.94 ± 0.39 (1.95-3.68)	3.00 ± 0.46 (1.8-3.88)	0.38
Gender (female)	9 (60%)	21 (43.7%)	16 (44.4%)	0.80
Parity (primi)	7 (46.6%)	18 (37.5%)	21 (58.3%)	0.07
Preterm delivery	3 (20%)	7 (14.5%)	9 (25%)	0.485
Gestational age of included preterms (weeks)	34.51 ± 1.62 (32^{+6}-36^{+5})	35.18 ± 1.01 (35^{+2}-36^{+6})	35.55 ± 1.17 (34^{+4}-36^{+6})	0.625
Fetal distress	9 (60%)	32 (66%)	25 (70%)	0.425
Apgar score at 1 minute	7.88 ± 0.48	7.83 ± 0.56	7.83 ± 0.6	0.91

Data are presented as mean ± SD (and range) or n (%).
PDSA: Plan-Do-Study-Act; PDSA-1: first PDSA cycle; PDSA-2: second PDSA cycle; QI: quality improvement.

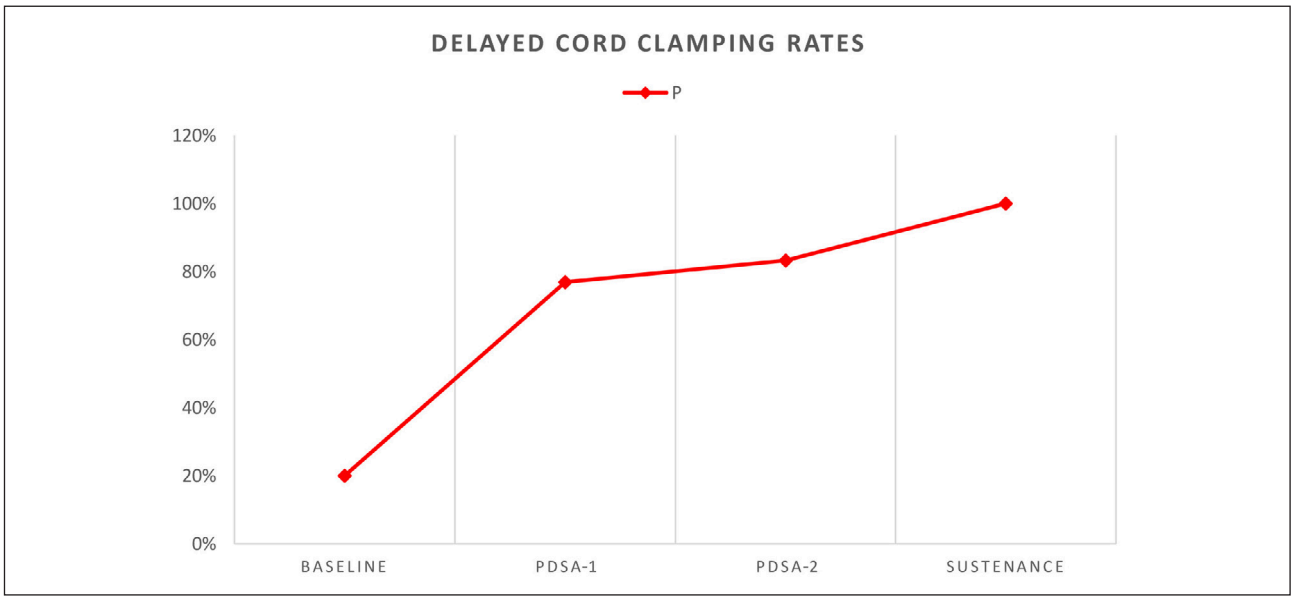

Figure 3. P-chart displaying the proportion of delayed cord clamping (DCC) in neonates delivered by caesarean section (CS) in baseline, first Plan-Do-Study-Act (PDSA) cycle (PDSA-1), second PDSA cycle (PDSA-2) and sustenance phase of the study.
PDSA: Plan-Do-Study-Act; PDSA-1: first PDSA cycle; PDSA-2: second PDSA cycle.

Discussion

As a QI project, we could successfully implement DCC in around 83% of the caesarean deliveries at the end of PDSA-2 and reached 100% in the sustenance phase among vigorous term and preterm neonates. Apart from wide dissemination of knowledge about evidence-based practice of DCC among team members, many self-innovative strategies such as provision of time keeping by a dedicated nursing staff with stop watch, "cord clamp clock" in OT, communicating clinical status of DCC neonates to the obstetrics team, precautionary measures for prevention of hypothermia during preterm delivery and tactile stimulation with intact cord took pivotal role for its implementation.

The safety, efficacy as well as feasibility of performing DCC is established in previous studies involving both preterm and term deliveries [4, 10-13]. A systematic review and meta-analysis by Fogarty et al. concluded that DCC decreases mortality and need of blood transfusions in preterm neonates without increasing the proportion with low Apgar scores or need for cardiorespiratory support or neonatal resuscitation at delivery [7]. And at the same time it has no impact on maternal post-partum haemorrhage or need of maternal blood transfusion [7, 14, 15]. In a randomised control trial, practice of DCC in elective CS showed improvement in the haematocrit of the term neonates without any increase in maternal blood loss [3]. Prior to QI, the practice rate was limited to 20% in our institute, preferentially executed during the presence of senior faculty members and mostly confined to elective cases with previous CS. As the implementation of DCC is one of the most cost effective and easy intervention we undertook this initiative in caesarean born neonates, after implementing in vaginal delivery cases (unpublished data).

The major barrier for the DCC was the inherent bias of both the obstetrician and neonatal team towards immediate clamping of the cord and shifting of the neonate to the radiant warmer to avoid any delay in resuscitation. For a developing country like India the delivery room newborn care corner in many centres is not well equipped, lacks skilled manpower and the condition is worse in the rural areas [16]. In many parts of our country, neonatal resuscitation is limited to provision of positive pressure ventilation in contrast to intensive care like set up in delivery room area in developed countries like the USA. There is also a dearth of availability of multimodal thermal management equipments as thermal mattress, heated humidified gas source, polyethylene/plastic bags for maintenance of temperature in preterms after delivery.

In a cross-sectional survey in the USA, around 73-79% obstetricians waited for at least 30 seconds for CC in preterm vaginal birth [17]. In another study DCC rate in caesarean delivery varied from 37% to 61% and the practice was influenced by hospital annual CS rates [18]. Recently, Pauley and team successfully implemented ACOG recommendation into clinical practice through a QI study and achieved 96% DCC rate over 6 weeks with a single PDSA cycle [19]. In this context a nationwide survey is required to collect data on CC practices in India and multiple role model QI initiatives are timely needed to implement such a cost effective intervention at large scales.

DCC is the delivery room strategy for prevention of neonatal anaemia. Banerjee et al. found association of lower birth haemoglobin level with neonatal morbidities in preterm babies [20]. In our study during the implementation phase (PDSA-1 and PDSA-2) DCC was practiced in 11 out of 14 very preterm deliveries, which reinforced achieving 100% DCC rate in all the eligible caesarean deliveries with gestational age between 28 weeks to 32 weeks in the sustenance phase. In a study by Ruangkit et al., DCC was achieved in 77% preterm (< 34 weeks) babies over 1 year through the meticulous adherence to protocol guided practice of DCC [21]. Similarly, Bolstridge et al. improved their hospital DCC rate from 0% to 73% in very low birthweight infants through multiple PDSA cycles and achieved 93.7% compliance rate during the maintenance phase [22]. Though the optimal timing of CC is not well defined, higher haematocrit levels are achieved with delaying ≥ 60 seconds as compared to 30 seconds without further significant benefits or adverse maternal and neonatal outcomes in previous studies [3, 23]. Although our initial target was to delay CC for ≥ 30 seconds with the boost in confidence of QI team members, in about 50% of cases CC was practiced ≥ 60 seconds in the sustenance period.

The study site being a teaching tertiary care setting, majority of CS are primarily based on feto-maternal obstetric indications. The critical decision of CC is based on the state of the neonate (vigorous vs non-vigorous) immediately after birth as well as obstetrician's discretion. But the collaborative decision of paediatrician and obstetrician prior to CS proved to be a great drive for successful implementation of DCC. With the

practice of tactile stimulation with intact cord by the obstetrician (in the absence of thick meconium stained liquor), DCC was performed in 7 deliveries even in the presence of fetal distress. This novel approach further added to the confidence of the team members to provide additional measures so as to avoid immediate CC in the background of fetal distress. The feasibility and physiological benefit of neonatal resuscitation with intact cord has been explored recently [24]. To give more importance to the timing of CC, with the suggestion of the QI team a large sized wall clock with second hands was installed in the OT. We designated it as the "cord clamp clock" as a continued reminder for DCC. Cord milking was not performed in this study and it may be recommended in future for babies more than 28 weeks where DCC could not be done. The trends of heart rate immediately after birth are better assessed by devices like pulse oximeter and ECG within a shortest window period in comparison to conventional precordium auscultation. The display of heart rate, an important objective parameter of neonatal resuscitation, may help the perinatal team for optimal time for placental transfusion.

This is a monocentric attempt to implement an evidence-based science to practice in a teaching hospital without any extra cost and may be projected as a role model in the perinatal practice of this regional area. This is one of our institutional QI projects, in which further decline in achieved DCC rate was not observed till the drafting of this manuscript. Through proper dissemination of scientific content, team initiative and various newer strategies, along with frequent monitoring by PDSA cycles, the targets of DCC project could be achieved within a short time span.

Declaration of interest

The Authors declare that there is no conflict of interest.

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