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Fetoplacental Doppler, Amniotic Fluid, and Placental Maturity in Pregnancies at or Beyond 40 Weeks: A Hospital-Based Observational Study

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Abstract

Background: Pregnancies extending beyond 40 completed weeks are associated with progressive changes in placental function and fetal well-being. Assessment of fetoplacental Doppler parameters, amniotic fluid volume, and placental maturity may provide complementary information for antenatal surveillance. This study evaluated these parameters and their relationship with maternal and neonatal outcomes in pregnancies at or beyond 40 weeks.

Methods: A hospital-based observational study was conducted among 139 women with singleton pregnancies at or beyond 40 completed weeks of gestation. Maternal and obstetric characteristics were recorded, and antenatal assessment included umbilical artery (UA) and middle cerebral artery (MCA) Doppler velocimetry, amniotic fluid index (AFI), and placental maturity according to Grannum grading. Labour characteristics, mode of delivery, maternal complications, and neonatal outcomes were documented. Participants were categorized according to gestational age as 40-40+6 weeks, 41-41+6 weeks, and ≥42 weeks.

Results: Of the 139 participants, 110 (79.1%) were at 40-40+6 weeks, 25 (18.0%) at 41-41+6 weeks, and four (2.9%) at ≥42 weeks. Mean UA resistance increased with advancing gestation, with the UA resistance index (RI) increasing from 0.57 to 0.60 and 0.61 and the UA pulsatility index (PI) from 0.84 to 0.88 and 1.12 across the three gestational-age groups, respectively. The derived cerebroplacental ratio (CPR) declined from 1.90 to 1.70 and 1.16. Oligohydramnios (AFI <5 cm) was present in 21 (15.1%) women, while meconium-stained liquor occurred in 40 (28.8%). Labour was induced in 70 (50.4%) women, and lower segment caesarean section (LSCS) was performed in 49 (35.3%), with fetal distress being the leading indication. Eight neonates (5.7%) required neonatal intensive care unit (NICU) admission, and no perinatal mortality was recorded.

Conclusion: Advancing gestational age beyond 40 weeks was accompanied by increasing umbilical artery Doppler resistance, declining derived CPR, reduced amniotic fluid, and progressive placental maturation. Integrated surveillance using Doppler assessment, AFI, and placental evaluation may assist in monitoring pregnancies extending beyond 40 weeks. The derived CPR findings should be interpreted cautiously because of limitations in directly recorded MCA PI measurements.

Categories: Obstetrics/Gynecology, Family/General Practice, Preventive Medicine
Keywords: amniotic fluid index, cerebroplacental ratio, fetoplacental doppler, maternal and perinatal outcome, middle cerebral artery doppler, placental maturity, post-term pregnancy, umbilical artery doppler

Introduction

Pregnancy extending beyond the expected date of delivery represents an important clinical transition in which the balance between continued fetal maturation and the increasing possibility of placental insufficiency becomes progressively relevant. Contemporary obstetric terminology distinguishes full-term pregnancy (39+0 to 40+6 weeks), late-term pregnancy (41+0 to 41+6 weeks), and post-term pregnancy (≥42+0 weeks), emphasizing that pregnancies beyond 40 weeks are not a homogeneous clinical group [1]. Although many pregnancies continuing beyond 40 weeks remain uncomplicated, advancing gestational age is associated with increasing risks of oligohydramnios, meconium passage, abnormal fetal heart-rate patterns, operative delivery, and adverse perinatal outcomes.

Evidence summarized by the World Health Organization indicates that stillbirth and neonatal mortality risks increase with advancing gestational age, particularly beyond 41 weeks, supporting continued fetal surveillance and consideration of delivery at or beyond 41 weeks in appropriately dated pregnancies [2]. The biological basis for these concerns is thought to involve progressive placental ageing and alterations in fetoplacental circulation. Placental insufficiency may result in increased vascular resistance within the placental circulation, while fetal adaptive mechanisms may alter cerebral blood flow. Doppler velocimetry of

the umbilical artery (UA) and middle cerebral artery (MCA) provides a non-invasive assessment of these hemodynamic changes. The UA pulsatility index (PI), resistance index (RI), and systolic/diastolic ratio reflect downstream placental vascular resistance, whereas MCA Doppler parameters provide information regarding fetal cerebral circulation. The cerebroplacental ratio (CPR), calculated from MCA and UA Doppler indices, has consequently been investigated as an integrated marker of fetal circulatory adaptation [3,4].

Previous studies have demonstrated an association between Doppler abnormalities and adverse outcomes in prolonged pregnancies. A prospective study of 118 uncomplicated pregnancies at 41 weeks evaluated MCA PI, UA PI, CPR, and amniotic fluid volume and examined their relationship with meconium-stained liquor, demonstrating the potential value of combining Doppler and amniotic-fluid assessment in surveillance of postdated pregnancies [5]. Earlier prospective work similarly evaluated UA and MCA Doppler in post-term pregnancies with otherwise reassuring conventional surveillance, suggesting that Doppler assessment may provide additional information regarding fetal condition [6]. The CPR has received considerable attention because it integrates placental resistance with fetal cerebral circulation. A systematic review found that a low CPR at term was associated with caesarean delivery for fetal compromise, meconium-stained liquor, low Apgar score, and neonatal intensive care admission, although the authors emphasized that evidence was insufficient to establish CPR as a stand-alone clinical test [3]. A subsequent large meta-analysis also found that CPR could provide prognostic information beyond some conventional Doppler measures, but substantial heterogeneity and methodological limitations were identified across studies [4]. More recent individual-participant-data analysis, however, reported that adding CPR to UA PI produced little additional predictive value for adverse perinatal outcome, illustrating that the clinical utility of CPR remains context-dependent [7].

Amniotic fluid assessment is another established component of fetal surveillance in prolonged pregnancy. Declining amniotic fluid volume may accompany placental dysfunction and can increase the risk of umbilical-cord compression and intrapartum fetal compromise. Clinical guidance recognizes reduced amniotic fluid as one of the important concerns when pregnancy extends beyond the expected date of delivery [8]. Placental maturity assessment using the Grannum grading system provides a structural assessment of placental maturation and calcification. However, placental morphology does not necessarily correspond directly to functional placental performance, making simultaneous assessment of placental maturity, amniotic fluid, and fetal circulation potentially more informative than any single parameter.

Despite extensive literature concerning prolonged pregnancy, important gaps remain. Much of the available evidence evaluates single surveillance parameters, particularly CPR or amniotic fluid, or focuses on selected high-risk populations such as fetal growth restriction. Furthermore, evidence regarding Doppler findings specifically across the transition from 40 weeks to late-term and post-term gestation is heterogeneous, and studies differ in Doppler thresholds, outcomes, and populations [7]. Importantly, the evidence does not establish that CPR should universally replace conventional surveillance or that it is necessarily superior to UA Doppler in all pregnancies. Therefore, an integrated assessment of fetoplacental Doppler velocimetry, amniotic fluid volume, placental maturity, and maternal and neonatal outcomes may provide a more comprehensive description of the physiological changes accompanying advancing gestation. The present hospital-based observational study was undertaken to characterize these parameters among pregnancies at or beyond 40 completed weeks and to examine their relationships with obstetric and neonatal outcomes. The study is intended to provide clinically relevant local evidence while avoiding the assumption that any single parameter, particularly CPR, is independently superior to other components of fetal surveillance.

Objectives

The present study aimed to evaluate fetoplacental Doppler velocimetry, amniotic fluid volume, and placental maturity among women with singleton pregnancies at or beyond 40 completed weeks of gestation. Specifically, the study sought to describe changes in umbilical artery and middle cerebral artery Doppler parameters with advancing gestational age, assess amniotic fluid volume and the occurrence of oligohydramnios, and evaluate placental maturity according to Grannum grading.

Materials And Methods

This was a hospital-based, descriptive observational study conducted from April 2025 to September 2026 in the Department of Obstetrics and Gynaecology, Dhiraj General Hospital, Vadodara, Gujarat, India, to evaluate fetoplacental Doppler parameters, amniotic fluid volume, placental maturity, and maternal and neonatal outcomes among pregnancies at or beyond 40 completed weeks of gestation. The study was observational, with no alteration of routine obstetric management solely for research purposes.

The study proposal was approved by the Sumandeep Vidhyapeeth Institutional Ethics Committee (approval number: SVIEC/ON/Medi/12P/Aug/26/2). Participants received a participant information sheet in a language they understood, and the study purpose, procedures, potential risks and benefits, voluntary nature of participation, and confidentiality provisions were explained before written informed consent was obtained. Participant privacy and confidentiality were maintained throughout the study, and refusal to participate did not affect routine clinical care.

Study population

Pregnant women presenting to the obstetric outpatient department and labour room during the study period who fulfilled the eligibility criteria were screened for participation. The study population comprised pregnant women with singleton pregnancies who had reached or exceeded 40 completed weeks of gestation. Gestational age was determined using the first day of the last menstrual period in women with reliable menstrual dates and by first-trimester ultrasonography when menstrual dating was uncertain or unreliable.

Women were eligible if they had a singleton pregnancy with vertex/cephalic presentation, had reached or exceeded 40 completed weeks of gestation, had reliable menstrual dating or first-trimester ultrasonographic dating, and were willing to participate. The study primarily included uncomplicated antenatal women who had crossed the expected date of delivery. Women with multiple gestation, non-vertex presentation, major congenital fetal anomalies, diabetes mellitus, antepartum haemorrhage, premature rupture of membranes, pregnancy-induced hypertension, chronic hypertension, heart disease, chronic renal disease, previous caesarean section, unreliable menstrual dating without first-trimester ultrasonography, or unwillingness to participate were excluded.

The required sample size was initially calculated using a prevalence-based formula, assuming a prevalence of post-dated pregnancy of 17.6%, a 95% confidence level, and a 7% allowable margin of error. The calculated minimum sample size was 115 participants, which was increased by 10% to account for anticipated non-response, giving a final target of approximately 139 participants. Ultimately, 139 women were included in the analysis.

The resulting estimate was intended as a general recruitment target and was not calculated to provide specified statistical power for comparisons of Doppler indices, amniotic fluid volume, placental maturity, or perinatal outcomes within the enrolled cohort. Accordingly, the analyses are interpreted in the context of the achieved sample size, particularly the limited number of participants at ⩾42 weeks.

Procedure

After obtaining ethical approval, eligible women attending the obstetric outpatient department or labour room were screened. Following provision of the participant information sheet and written informed consent, detailed menstrual, obstetric, medical, personal, and relevant family histories were recorded, followed by general and obstetric examination.

Gestational age was established using Naegele's formula or first-trimester ultrasonography. Participants were followed through labour, and induction of labour, methods used for induction, mode of delivery, indications for operative delivery, and maternal and fetal outcomes were documented. The temporal relationship between ultrasonographic assessments and induction or labour onset was considered when interpreting the findings. Associations between antenatal measurements and subsequent obstetric outcomes were interpreted cautiously, given the observational study design. Decisions regarding obstetric management were taken by the treating obstetric team.

Doppler assessment included the RI, PI, systolic/diastolic ratio, and peak systolic velocity of the UA and MCA. Amniotic fluid index was assessed by ultrasonography, while placental maturity was classified according to the Grannum system.

Amniotic fluid volume was assessed using the four-quadrant amniotic fluid index (AFI) technique originally described by Phelan et al., in which the maximum vertical pocket in each of the four uterine quadrants is measured, and the four measurements are summed to obtain the AFI [9]. Placental maturity was assessed ultrasonographically according to the Grannum grading system described by Grannum et al. [10]. Fetoplacental circulation was assessed using umbilical artery Doppler velocimetry, with RI, PI, systolic/diastolic (S/D) ratio, and peak systolic velocity recorded according to standard Doppler waveform methodology [11]. Where reported, the CPR was calculated from the MCA and UA Doppler indices.

Data collection

Data were collected using a standardized case record form, with participant information and clinical findings recorded systematically. Clinical and obstetric decisions remained under the supervision of qualified obstetricians. Data were checked for completeness and consistency before entry and analysis. The study tool recorded sociodemographic characteristics, obstetric history, gestational age, mode and indication of delivery, Doppler parameters of the umbilical artery and middle cerebral artery, amniotic fluid index, liquor characteristics, placental maturity according to Grannum grading, and maternal and neonatal outcomes. Maternal outcomes included mode of delivery and relevant intrapartum complications. Neonatal outcomes included Apgar status, birth asphyxia, meconium aspiration, neonatal intensive care unit (NICU) admission, and perinatal mortality.

Data analysis

Collected data were entered into an Excel spreadsheet (Microsoft Corporation, Redmond, Washington, United States) and analyzed using statistical software, JAMOVI version 2.6.44 (The Jamovi Project, Sydney, Australia) and RStudio version 4.5.3 (Posit PBC, Boston, Massachusetts, United States). Categorical variables, including gestational-age category, placental maturity grade, AFI category, mode of delivery, induction of labour, maternal complications, and neonatal outcomes, were summarized as frequencies and percentages. Continuous variables, including maternal age, gestational age in days, birth weight, and measured Doppler indices, were summarized using means and standard deviations (SDs), where appropriate. The study analysis was predominantly descriptive; therefore, no inferential estimates are assigned to reconstructed or estimated MCA PI or CPR values. Findings are interpreted as descriptive associations and not as evidence of causation.

The indications for caesarean section were recorded from the available obstetric documentation. Fetal distress was documented as the indication in 32 of 49 caesarean deliveries (65.3%). However, the source records available for this analysis did not consistently specify the individual clinical or cardiotocographic findings underlying this classification. Accordingly, fetal distress was analyzed as a recorded clinical indication rather than as an independently validated outcome based on predefined diagnostic criteria.

Results

Participant characteristics

A total of 139 women with pregnancies at or beyond 40 completed weeks were included in the study. The mean maternal age was 24.94 ± 4.75 years, with the largest proportion aged 21-25 years (n=48, 34.5%), followed by 26-30 years (n=44, 31.7%). Most participants were booked cases (n=124, 89.2%), had primary-level education (n=84, 60.4%), and belonged to the low socioeconomic group (n=122, 87.8%). Primiparous women constituted 87 (62.6%) of the study population. The mean gestational age was 284.9 ± 2.8 days; 110 women (79.1%) were at 40-40+6 weeks, 25 (18.0%) at 41-41+6 weeks, and four (2.9%) at ⩾42 weeks (Table *1*).

Characteristic		Frequency (percentage)
Age group	<20 years	29 (20.9)
	21–25 years	48 (34.5)
	26–30 years	44 (31.7)
	>30 years	18 (12.9)
Booked admission		124 (89.2)
Obstetric history	Primiparous	87 (62.6)
	Multiparous	52 (37.4)
Gestational age	40–40+6 weeks	110 (79.1)
	41–41+6 weeks	25 (18.0)
	≥42 weeks	4 (2.9)

TABLE 1: Baseline demographic and obstetric characteristics of the study population (N = 139)

Labour and mode of delivery

Labour was induced in 70 women (50.4%), while 69 (49.6%) entered labour spontaneously. Vaginal delivery occurred in 78 women (56.1%), while 49 underwent lower segment caesarean section (LSCS) (35.3%). Eight women (5.7%) required vacuum-assisted delivery and four (2.9%) underwent forceps-assisted delivery. Among the 49 women undergoing LSCS, fetal distress was the leading indication (n=32, 65.3%), followed by oligohydramnios (n=8, 16.3%), cephalopelvic disproportion (n=5, 10.2%), and maternal request (n=4, 8.2%) (Table *2*).

Variable	Frequency (Percentage)
Induced labour	70 (50.4)
Spontaneous labour	69 (49.6)
Vaginal delivery	78 (56.1)
LSCS	49 (35.3)
Vacuum-assisted delivery	8 (5.7)
Forceps-assisted delivery	4 (2.9)
Indications among LSCS cases (n=49)	
Fetal distress	32 (65.3)
Oligohydramnios	8 (16.3)
Cephalopelvic disproportion	5 (10.2)
Maternal request	4 (8.2)

TABLE 2: Labour characteristics and mode of delivery

LSCS: lower segment caesarean section

Doppler findings

UA Doppler indices showed a progressive increase across gestational-age categories. Mean UA RI increased from 0.57 at 40-40+6 weeks to 0.60 at 41-41+6 weeks and 0.61 at ⩾42 weeks. Mean UA PI increased from 0.84 to 0.88 and 1.12, respectively, while the S/D ratio increased from 1.77 to 1.82 and 2.20. UA peak systolic velocity (PSV) remained relatively stable. The reported derived CPR decreased from 1.90 at 40-40+6 weeks to 1.70 at 41-41+6 weeks and 1.16 at ⩾42 weeks (Figure *1*). Because MCA PI values used for CPR were estimated from observed trends rather than directly recorded measurements, these CPR findings are presented descriptively and should not be interpreted as evidence of diagnostic superiority.

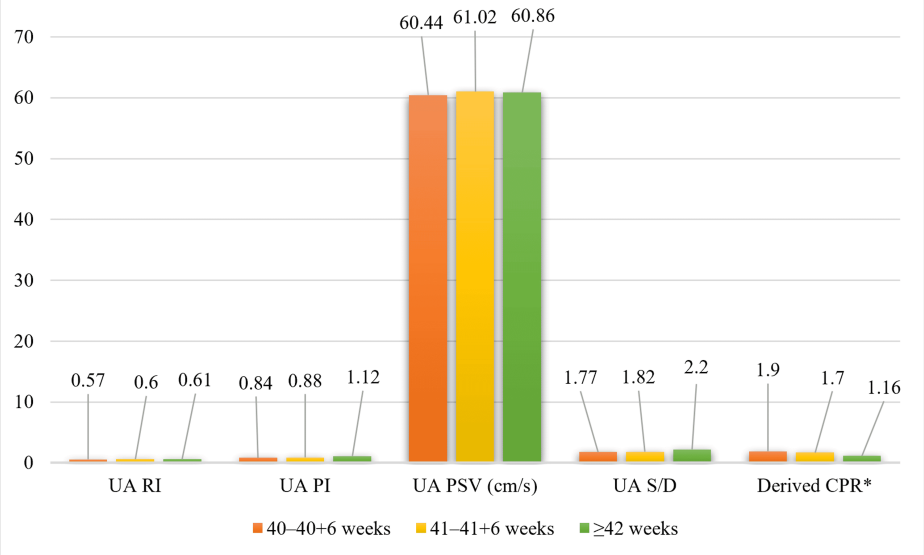


FIGURE 1: Doppler velocimetry parameters according to gestational age

UA: umbilical artery; RI: resistance index; PSV: peak systolic velocity; PI: pulsatility index; CPR: cerebroplacental ratio

Amniotic fluid and placental findings

Oligohydramnios (AFI <5 cm) was present in 21 women (15.1%). AFI of 5-8 cm was observed in 68 (48.9%), 9-10 cm in 34 (24.4%), and >10 cm in 16 (11.6%). Clear liquor was documented in 99 women (71.2%), whereas 40 (28.8%) had meconium-stained liquor (Figure 2).

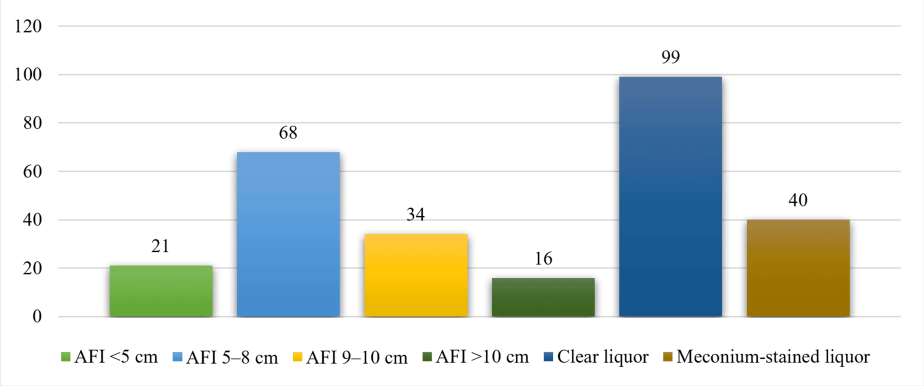


FIGURE 2: Amniotic fluid index (AFI) and liquor characteristics (N = 139)

Grade II was reported as the predominant placental maturity grade at 40-40+6 and 41-41+6 weeks. Among women with oligohydramnios, 15 (71.4%) had Grade III placental maturity, four (19.0%) had Grade II, and two (9.5%) had Grade I (Figure 3).

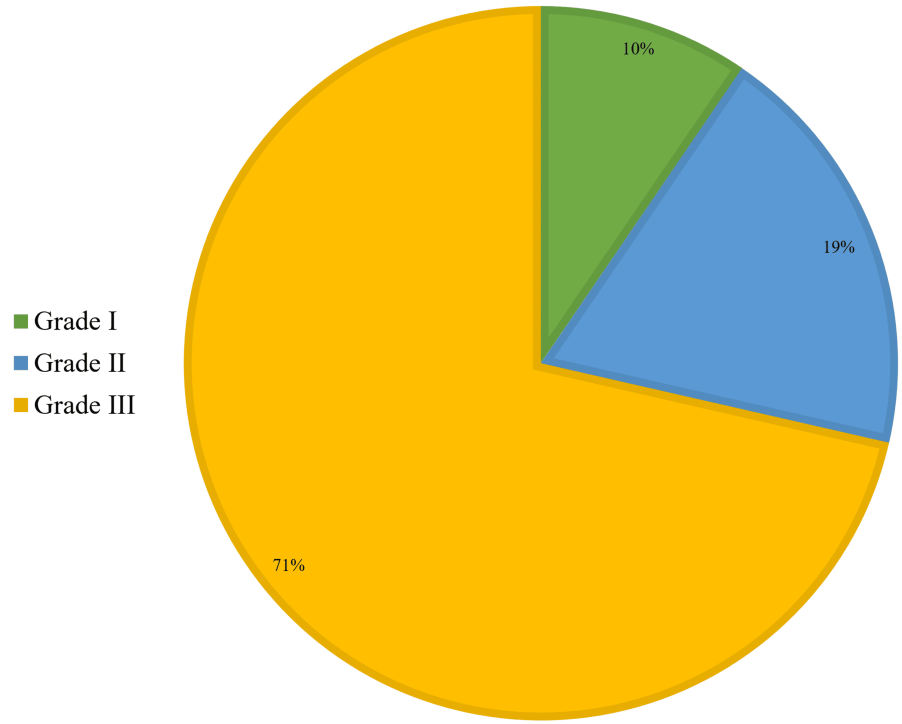


FIGURE 3: Distribution of oligohydramnios according to placental maturity

Maternal and neonatal outcomes

The mean birth weight was 2.70 ± 0.31 kg; 48 neonates (34.5%) weighed <2.5 kg, 75 (54.0%) weighed 2.5-3.0 kg, and 16 (11.5%) weighed >3.0 kg. All 139 neonates had Apgar scores ⩾7 at one and five minutes. Eight neonates required NICU admission, with birth asphyxia and respiratory distress each reported in four cases; no perinatal mortality occurred. Maternal complications were absent in 115 women (82.7%); the recorded complications included manual removal of placenta (n=6, 4.4%), vulval hematoma (n=6, 4.4%), cervical tear (n=5, 3.6%), perineal tear (n=4, 2.9%), atonic postpartum haemorrhage (n=3, 2.2%), and distended bladder (n=2, 1.4%) (Table 3).

Outcome		Frequency (Percentage)
Birth weight	<2.5 kg	48 (34.5)
	2.5–3.0 kg	75 (54.0)
	>3.0 kg	16 (11.5)
Apgar ≥7	At 1 minute	139 (100.0)
	At 5 minutes	139 (100.0)
NICU admission		8 (5.7)
Birth asphyxia		4 (2.9)
Respiratory distress		4 (2.9)
Perinatal mortality		0
No maternal complication		115 (82.7)
Manual removal of placenta		6 (4.4)
Vulval hematoma		6 (4.4)
Cervical tear		5 (3.6)
Perineal tear		4 (2.9)
Atonic PPH		3 (2.2)
Distended bladder		2 (1.4)

TABLE 3: Maternal and neonatal outcomes

PPH: postpartum haemorrhage

Discussion

Pregnancies extending beyond 40 completed weeks require continued fetal surveillance because the risks associated with advancing gestational age are not uniform across the term period. The American College of Obstetricians and Gynecologists (ACOG) distinguishes full-term pregnancy from late-term (41+0 to 41+6 weeks) and post-term pregnancy (⩾42+0 weeks), emphasizing that advancing gestation is associated with progressively increasing perinatal risks in some pregnancies [1]. In the present study, most participants (79.1%) were at 40-40+6 weeks, while 18.0% were at 41-41+6 weeks and only 2.9% were ⩾42 weeks. This distribution is clinically relevant because contemporary recommendations support increased surveillance and consideration of delivery as gestation advances beyond 41 weeks [2,7].

A principal finding of the present study was the progressive increase in UA Doppler resistance with advancing gestational age. Mean UA RI increased from 0.57 at 40-40+6 weeks to 0.60 at 41-41+6 weeks and 0.61 at ⩾42 weeks, while UA PI increased from 0.84 to 0.88 and 1.12, respectively. Similarly, the UA S/D ratio increased from 1.77 to 1.82 and 2.20. These findings suggest increasing fetoplacental vascular resistance in pregnancies progressing beyond 40 weeks. Earlier work in post-term pregnancies demonstrated that Doppler assessment could provide additional information regarding fetal status even when conventional surveillance was reassuring [5]. Similarly, studies evaluating Doppler cerebroplacental blood flow together with amniotic fluid volume have supported an integrated approach to surveillance of postdated pregnancies [4].

In the present study, the derived CPR showed a decline from 1.90 at 40-40+6 weeks to 1.70 at 41-41+6 weeks and 1.16 at ⩾42 weeks. Physiologically, a lower CPR may reflect increasing placental resistance together with redistribution of fetal circulation toward the cerebral circulation. Previous systematic reviews have reported associations between abnormal CPR and adverse perinatal outcomes, including operative delivery for fetal compromise and neonatal morbidity [2,3]. However, the evidence regarding the incremental clinical value of CPR remains heterogeneous. An individual-participant-data meta-analysis found that the addition of CPR to UA PI provided limited additional prognostic information for adverse perinatal outcomes [4]. Therefore, the declining CPR observed in the present study should be interpreted as an observational Doppler pattern rather than evidence that CPR is a superior or more sensitive surveillance test. This interpretation is particularly important because the MCA PI values used for CPR in the present dataset were derived rather than consistently available as directly recorded measurements. Amniotic fluid findings provided another

important component of the observed pattern. Oligohydramnios (AFI <5 cm) was present in 15.1% of participants, while almost half had an AFI of 5-8 cm. Meconium-stained liquor occurred in 28.8% of women. Reduced amniotic fluid in late-term and post-term pregnancy is clinically relevant because it may accompany declining placental function and increase the possibility of umbilical-cord compression and intrapartum fetal compromise. The coexistence of reduced amniotic fluid and increasing UA resistance therefore supports the concept that multiple surveillance parameters may provide complementary information rather than relying on a single measurement [4,7].

Placental maturity findings were also consistent with progressive placental maturation in advancing gestation. Grade II predominated among women at 40-40+6 and 41-41+6 weeks, whereas more advanced placental maturation was observed among women with oligohydramnios. Nevertheless, placental Grannum grade represents a morphological assessment and should not be considered synonymous with functional placental insufficiency. Thus, placental maturity is best interpreted alongside Doppler and amniotic fluid findings rather than as an independent marker of fetal compromise. The study also demonstrated clinically relevant obstetric outcomes. Labour was induced in 50.4% of participants, while LSCS occurred in 35.3%, with fetal distress accounting for 65.3% of caesarean indications. NICU admission occurred in 5.7% of neonates, and no perinatal mortality was recorded. These findings are broadly compatible with the rationale underlying recommendations for induction at or beyond term, which seek to reduce adverse perinatal outcomes associated with continued pregnancy [2,7]. However, because this was a descriptive observational study without a comparison group, these findings cannot establish that the Doppler or amniotic-fluid abnormalities caused the delivery or neonatal outcomes.

The findings support an integrated approach to surveillance of pregnancies at or beyond 40 weeks, incorporating fetal Doppler, amniotic fluid assessment, and placental evaluation. The study should nevertheless be interpreted in light of its observational design, hospital-based sampling, small number of pregnancies beyond 42 weeks, and the derived nature of the reported CPR. The results therefore provide descriptive evidence of changing fetoplacental and amniotic-fluid parameters with advancing gestation rather than establishing the diagnostic superiority of any individual surveillance parameter.

This study has several limitations. Its hospital-based observational design and purposive sampling may limit the generalizability of the findings to other populations and settings. The number of women with pregnancies ⩾42 weeks was small, limiting meaningful comparison of this subgroup. The absence of a non-postdated comparison group also restricts assessment of the independent effect of advancing gestational age. In addition, the study was primarily descriptive and cannot establish causal relationships between Doppler findings, amniotic fluid, placental maturity, and neonatal outcomes.

Conclusions

In this hospital-based observational study of pregnancies at or beyond 40 completed weeks, advancing gestational age was accompanied by increasing umbilical artery Doppler resistance, declining derived cerebroplacental ratio, reduced amniotic fluid volume, and greater placental maturity. Oligohydramnios and meconium-stained liquor were observed in a clinically relevant proportion of women, while fetal distress constituted the major indication for caesarean delivery. However, the findings should be interpreted cautiously because of the observational design, the small number of pregnancies beyond 42 weeks, and limitations related to the derived CPR measurements. Further prospective studies with larger samples and directly measured Doppler parameters are warranted to clarify their predictive value for adverse perinatal outcomes.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Acquisition, analysis, or interpretation of data: Madhumita Bhakta, Yukta R. Gupta, Dhruvit K. Dholakiya

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Critical review of the manuscript for important intellectual content: Radhika Parmar, Dhruvit K. Dholakiya

Supervision: Radhika Parmar, Dhruvit K. Dholakiya

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Sumandeep Vidhyapeeth Institutional Ethics Committee issued approval SVIEC/ON/Medi/12P/Aug/26/2. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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