Evidence Summary

There is currently a lack of consensus among existing national guidelines in regard to the optimal interval of monitoring for intrauterine growth retardation, (McGowan, L.M. et al, 2018) with recommended intervals ranging from 2-4 weeks.

Ultrasound scanning at 2 week intervals has been found to be associated with false-positive rates (in excess of 10%), increasing to much higher rates late in the third trimester (Mongelli, M et al, 1998). As such, ultrasound scanning for surveillance of IUGR is not recommended at a frequency of more than every two weeks (ACOG, 2013).

1. Evidence-based national guidelines for the management of suspected fetal growth restriction: comparison, consensus, and controversy

Author(s): McCowan L.M.; Anderson N.H.; Figueras F.

Source: American Journal of Obstetrics and Gynecology; Feb 2018; vol. 218 (no. 2)

Publication Date: Feb 2018

Publication Type(s): Review

Abstract: Small for gestational age is usually defined as an infant with a birthweight <10th centile for a population or customized standard. Fetal growth restriction refers to a fetus that has failed to reach its biological growth potential because of placental dysfunction. Small-for-gestational-age babies make up 28-45% of nonanomalous stillbirths, and have a higher chance of neurodevelopmental delay, childhood and adult obesity, and metabolic disease. The majority of small-for-gestational-age babies are not recognized before birth. Improved identification, accompanied by surveillance and timely delivery, is associated with reduction in small-for-gestational-age stillbirths. Internationally and regionally, detection of small for gestational age and management of fetal growth problems vary considerably. The aim of this review is to: summarize areas of consensus and controversy between recently published national guidelines on small for gestational age or fetal growth restriction; highlight any recent evidence that should be incorporated into existing guidelines; and identify future research priorities in this field. A search of MEDLINE, Google, and the International Guideline Library identified 6 national guidelines on management of pregnancies complicated by fetal growth restriction/small for gestational age published from 2010
onwards. There is general consensus between guidelines (at least 4 of 6 guidelines in agreement) in early pregnancy risk selection, and use of low-dose aspirin for women with major risk factors for placental insufficiency. All highlight the importance of smoking cessation to prevent small for gestational age. While there is consensus in recommending fundal height measurement in the third trimester, 3 specify the use of a customized growth chart, while 2 recommend McDonald rule. Routine third-trimester scanning is not recommended for small-for-gestational-age screening, while women with major risk factors should have serial scanning in the third trimester. Umbilical artery Doppler studies in suspected small-for-gestational-age pregnancies are universally advised, however there is inconsistency in the recommended frequency for growth scans after diagnosis of small for gestational age/fetal growth restriction (2-4 weekly). In late-onset fetal growth restriction (&gt;=32 weeks) general consensus is to use cerebral Doppler studies to influence surveillance and/or delivery timing. Fetal surveillance methods (most recommend cardiotocography) and recommended timing of delivery vary. There is universal agreement on the use of corticosteroids before birth at &lt;34 weeks, and general consensus on the use of magnesium sulfate for neuroprotection in early-onset fetal growth restriction (&lt;32 weeks). Most guidelines advise using cardiotocography surveillance to plan delivery in fetal growth restriction &lt;32 weeks. The recommended gestation at delivery for fetal growth restriction with absent and reversed end-diastolic velocity varies from 32 to &gt;=34 weeks and 30 to &gt;=34 weeks, respectively. Overall, where there is high-quality evidence from randomized controlled trials and meta-analyses, eg, use of umbilical artery Doppler and corticosteroids for delivery &lt;34 weeks, there is a high degree of consistency between national small-for-gestational-age guidelines. This review discusses areas where there is potential for convergence between small-for-gestational-age guidelines based on existing randomized controlled trials of management of small-for-gestational-age pregnancies, and areas of controversy. Research priorities include assessing the utility of late third-trimester scanning to prevent major morbidity and mortality and to investigate the optimum timing of delivery in fetuses with late-onset fetal growth restriction and abnormal Doppler parameters. Prospective studies are needed to compare new international population ultrasound standards with those in current use. Copyright © 2017

Database: EMBASE
2. Optimal Interval between Ultrasound Scans for the Detection of Complications in Monochorionic Twins.

Author(s): McDonald, Rebecca; Hodges, Ryan; Knight, Michelle; Teoh, Mark; Edwards, Andrew; Neil, Peter; Wallace, Euan M; DeKoninck, Philip

Source: Fetal diagnosis and therapy; 2017; vol. 41 (no. 3); p. 197-201

Publication Date: 2017

Publication Type(s): Journal Article

PubMedID: 27561094

Abstract: INTRODUCTION Monochorionic-diamniotic (MCDA) twin pregnancies are high risk, due to twin-to-twin transfusion syndrome (TTTS), twin anaemia polycythaemia sequence (TAPS) and intrauterine growth restriction (IUGR). There is limited evidence to guide ultrasound surveillance protocols. Using a retrospective cohort, we aimed to provide insight into the optimal interval of ultrasound surveillance.

METHODS Retrospective cohort of women with MCDA pregnancies who received antenatal care at Monash Medical Centre (January 2011-October 2014). We reviewed all ultrasounds from ≥15 weeks' gestation and collected perinatal outcomes.

RESULTSA total of 162 women with MCDA pregnancies attended our care. Six women were excluded due to late referral. Of the remaining 156, 55% were uncomplicated. TTTS, TAPS, IUGR and fetal demise in utero occurred in 9%, 1%, 31% and 2%, respectively. Median interval between the last ultrasound and TTTS diagnosis was 3.1 weeks (IQR 0.8-5.8). There was a trend towards a longer interval for cases with advanced TTTS compared to early TTTS. Interval between ultrasound scans was longer in cases with unexplained fetal demise in utero and advanced TTTS than early TTTS [3.4 weeks (IQR 2.0-6.9) vs. 0.9 weeks (IQR 0.4-3.7); p < 0.05].

DISCUSSION Our observations support current recommendations for fortnightly ultrasound surveillance in MCDA pregnancies from 16 weeks' gestation and suggest that longer intervals may be associated with poorer outcomes.

Database: Medline
3. Does serial 3rd trimester ultrasound improve detection of small for gestational age babies: Comparison of screening policies in 2 European maternity units.

Author(s): Sokol Karadjole, Vesna; Agarwal, Umber; Berberovic, Edina; Poljak, Borna; Alfirevic, Zarko

Source: European journal of obstetrics, gynecology, and reproductive biology; Aug 2017; vol. 215; p. 45-49

Publication Date: Aug 2017

Publication Type(s): Journal Article

PubMedID: 28601727

Abstract: OBJECTIVE Methods for the antenatal detection of small for gestational age babies (SGA) differ between countries. The aim of this study was to compare the diagnostic accuracy of routine versus selective small for gestational age babies screening policy using data from two European Maternity Units. STUDY DESIGN This was a retrospective cohort study from Liverpool Women’s Hospital, UK, that uses selective third trimester sonography and from the University Hospital Centre Zagreb, Croatia, that uses routine third trimester sonography for SGA detection. Screen positive cases were defined as pregnancies with estimated fetal weight (EFW) <10th centile at the last 3rd trimester scan. True positives had both EFW and birth weight <10th centile. Pregnancy management data and perinatal outcomes were retrieved from hospital electronic data and special care baby unit (SCBU) reports. RESULTS The proportion of small for gestational age babies was higher in Liverpool (7.8%) compared with Zagreb (4%); P<0.001. Sensitivity for detection of SGA babies in Zagreb was 27% (95%CI 15%-44%) and 33% (95%CI 23%-45%) in Liverpool. The specificity was high in both centres (Zagreb 100% (95%CI); Liverpool 98% (95%CI)). The induction of labour for antenatally diagnosed SGA babies was more common in Liverpool (38.5%) than in Zagreb (9.1%). In both centres, all antenatally diagnosed SGA babies admitted to SCBU were preterm babies. Their indications for admission to SCBU were complications related to prematurity. CONCLUSION The effectiveness of selective SGA screening policy is comparable to universal third trimester ultrasound screening. Further prospective evaluations of SGA screening policies are warranted and they should include full cost-effectiveness analysis and assessment of possible harm from increased interventions leading to more preterm births.

Database: Medline

**Author(s):** Reboul, Q; Delabaere, A; Luo, Z C; Nuyt, A-M; Wu, Y; Chauleur, C; Fraser, W; Audibert, F

**Source:** Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology; Mar 2017; vol. 49 (no. 3); p. 372-378

**Publication Date:** Mar 2017

**Publication Type(s):** Comparative Study Multicenter Study Journal Article

**PubMedID:** 27153518

Available at Ultrasound in Obstetrics & Gynecology - from Wiley Online Library Science , Technology and Medicine Collection 2017

**Abstract:**

**OBJECTIVES**

To compare third-trimester ultrasound screening methods to predict small-for-gestational age (SGA), and to evaluate the impact of the ultrasound-delivery interval on screening performance.

**METHODS**

In this prospective study, data were collected from a multicenter singleton cohort study investigating the links between various exposures during pregnancy with birth outcome and later health in children. We included women, recruited in the first trimester, who had complete outcome data and had undergone third-trimester ultrasound examination. Demographic, clinical and biological variables were also collected from both parents. We compared prediction of delivery of a SGA neonate (birth weight < 10th percentile) by the following methods: abdominal circumference (AC) Z-score based on Hadlock curves (Hadlock AC), on INTERGROWTH-21st Project curves (Intergrowth AC) and on Salomon curves (Salomon AC); estimated fetal weight (EFW) Z-score based on Hadlock curves (Hadlock EFW) and on customized curves from Gardosi (Gardosi EFW); and fetal growth velocity based on change in AC between second and third trimesters (FGVAC). We also assessed the following ultrasound-delivery intervals: ≤ 4 weeks, ≤ 6 weeks and ≤ 10 weeks.

**RESULTS**

Third-trimester ultrasound was performed in 1805 patients with complete outcome data, of whom 158 (8.8%) delivered a SGA neonate. Ultrasound examination was at a median gestational age of 32 (interquartile range, 31-33) weeks. The ultrasound-delivery interval was ≤ 4 weeks in 17.2% of cases, ≤ 6 weeks in 48.1% of cases and ≤ 10 weeks in 97.3% of cases. Areas under the receiver-operating characteristics curve (AUC) were 0.772 for Salomon AC, 0.768 for Hadlock EFW, 0.766 for Hadlock AC, 0.765 for Intergrowth AC, 0.708 for Gardosi EFW and 0.674 for FGVAC (all P < 0.0001). The screening method with the highest AUC for an ultrasound-delivery interval ≤ 4 weeks was Salomon AC (AUC, 0.856), ≤ 6 weeks was Hadlock AC (AUC, 0.824) and ≤ 10 weeks was Salomon AC (AUC, 0.780). At a fixed 10% false-positive rate, the best detection rates were 60.0%, 54.1% and 42.1% for intervals ≤ 4, ≤ 6 and ≤ 10 weeks, respectively.

**CONCLUSION**

Third-trimester ultrasound measurements provide poor to moderate prediction of SGA. A shorter ultrasound-delivery interval provides better prediction than does a longer interval. Further studies are needed to test the effect of including maternal or biological characteristics in SGA screening. Copyright © 2016 ISUOG. Published by John Wiley & Sons Ltd.

**Database:** Medline
5. Single and Serial Fetal Biometry to Detect Preterm and Term Small- and Large-for-Gestational-Age Neonates: A Longitudinal Cohort Study.

**Author(s):** Tarca, Adi L; Hernandez-Andrade, Edgar; Ahn, Hyunyoung; Garcia, Maynor; Xu, Zhonghui; Korzeniewski, Steven J; Saker, Homam; Chaiworapongsa, Tinnakorn; Hassan, Sonia S; Yeo, Lami; Romero, Roberto

**Source:** PloS one; 2016; vol. 11 (no. 11); p. e0164161

**Publication Date:** 2016

**Publication Type(s):** Journal Article

**PubMedID:** 27802270

Available at [PLOS ONE](https://journals.plos.org/plosone) - from Europe PubMed Central - Open Access

Available at [PLOS ONE](https://journals.plos.org/plosone) - from Unpaywall

**Abstract:**

**OBJECTIVE** To assess the value of single and serial fetal biometry for the prediction of small- (SGA) and large-for-gestational-age (LGA) neonates delivered preterm or at term.

**METHODS** A cohort study of 3,971 women with singleton pregnancies was conducted from the first trimester until delivery with 3,440 pregnancies (17,334 scans) meeting the following inclusion criteria: 1) delivery of a live neonate after 33 gestational weeks and 2) two or more ultrasound examinations with fetal biometry parameters obtained at ≤36 weeks. Primary outcomes were SGA (95th centile) at birth based on INTERGROWTH-21st gender-specific standards. Fetus-specific estimated fetal weight (EFW) trajectories were calculated by linear mixed-effects models using data up to a fixed gestational age (GA) cutoff (28, 32, or 36 weeks) for fetuses having two or more measurements before the GA cutoff and not already delivered. A screen test positive for single biometry was based on Z-scores of EFW at the last scan before each GA cut-off so that the false positive rate (FPR) was 10%. Similarly, a screen test positive for the longitudinal analysis was based on the projected (extrapolated) EFW at 40 weeks from all available measurements before each cutoff for each fetus.

**RESULTS** Fetal abdominal and head circumference measurements, as well as birth weights in the Detroit population, matched well to the INTERGROWTH-21st standards, yet this was not the case for biparietal diameter (BPD) and femur length (FL) (up to 9% and 10% discrepancy for mean and confidence intervals, respectively), mainly due to differences in the measurement technique. Single biometry based on EFW at the last scan at ≤32 weeks (GA IQR: 27.4-30.9 weeks) had a sensitivity of 50% and 53% (FPR = 10%) to detect preterm and term SGA and LGA neonates, respectively (AUC of 82% both). For the detection of LGA using data up to 32- and 36-week cutoffs, single biometry analysis had higher sensitivity than longitudinal analysis (52% vs 46% and 62% vs 52%, respectively; both p<0.05). Restricting the analysis to subjects with the last observation taken within two weeks from the cutoff, the sensitivity for detection of LGA, but not SGA, increased to 65% and 72% for single biometry at the 32- and 36-week cutoffs, respectively. SGA screening performance was higher for preterm (<37 weeks) than for term cases (73% vs 46% sensitivity; p<0.05) for single biometry at ≤32 weeks. CONCLUSIONS When growth abnormalities are defined based on birth weight, growth velocity (captured in the longitudinal analysis) does not provide additional information when compared to the last measurement for predicting SGA and LGA neonates, with both approaches detecting one-half of the neonates (FPR = 10%) from data collected at ≤32 weeks. Unlike for SGA, LGA detection can be improved if ultrasound scans are scheduled as close as possible to the gestational-age cutoff when a decision regarding the clinical management of the patient needs to be made. Screening performance for SGA is higher for neonates that will be delivered preterm.

**Database:** Medline

**Author(s):** Henrichs, Jens; Verfaille, Viki; Viester, Laura; Westerneng, Myrte; Molewijk, Bert; Franx, Arie; van der Horst, Henriette; Bosmans, Judith E; de Jonge, Ank; Jellema, Petra; IRIS Study Group

**Source:** BMC pregnancy and childbirth; Oct 2016; vol. 16 (no. 1); p. 310

**Publication Date:** Oct 2016

**PubMedID:** 27737654

Available at [BMC pregnancy and childbirth](https://www.bmcmedicine.com) - from ProQuest (Hospital Premium Collection) - NHS Version

Available at [BMC pregnancy and childbirth](https://www.bmcmedicine.com) - from BioMed Central

**Abstract:**
BACKGROUND
Intrauterine growth retardation (IUGR) is a major risk factor for perinatal mortality and morbidity. Thus, there is a compelling need to introduce sensitive measures to detect IUGR fetuses. Routine third trimester ultrasonography is increasingly used to detect IUGR. However, we lack evidence for its clinical effectiveness and cost-effectiveness and information on ethical considerations of additional third trimester ultrasonography. This nationwide stepped wedge cluster-randomized trial examines the (cost-)effectiveness of routine third trimester ultrasonography in reducing severe adverse perinatal outcome through subsequent protocolized management.

METHODS
For this trial, 15,000 women with a singleton pregnancy receiving care in 60 participating primary care midwifery practices will be included at 22 weeks of gestation. In the intervention group (n = 7,500) and control group (n = 7,500) fetal growth will be monitored by serial fundal height assessments. All practices will start offering the control condition (ultrasonography based on medical indication). Every three months, 20 practices will be randomized to the intervention condition, i.e. apart from ultrasonography if indicated, two routine ultrasound examinations will be performed (at 28-30 weeks and 34-36 weeks). If IUGR is suspected, both groups will receive subsequent clinical management as described in the IRIS study protocol that will be developed before the start of the trial. The primary dichotomous clinical composite outcome is 'severe adverse perinatal outcome' up to 7 days after birth, including: perinatal death; Apgar score <4 at 5 minutes after birth; impaired consciousness; need for assisted ventilation for more than 24 h; asphyxia; septicemia; meningitis; bronchopulmonary dysplasia; intraventricular hemorrhage; cystic periventricular leukomalacia; neonatal seizures or necrotizing enterocolitis. For the economic evaluation, costs will be measured from a societal perspective. Quality of life will be measured using the EQ-5D-5 L to enable calculation of QALYs. Cost-effectiveness and cost-utility analyses will be performed. In a qualitative sub-study (using diary notes from 32 women for 9 months, at least 10 individual interviews and 2 focus group studies) we will explore ethical considerations of additional ultrasonography and how to deal with them.

DISCUSSION
The results of this trial will assist healthcare providers and policymakers in making an evidence-based decision about whether or not introducing routine third trimester ultrasonography.

**TRIAL REGISTRATION:** NTR4367 , 21 March 2014.

**Database:** Medline
Abstract: Introduction The UK’s stillbirth rate is the highest in western Europe. The RCOG’s Investigation and Management of the Small-For-Gestational-Age Fetus guideline defines major and minor risk factors for fetal growth restriction (FGR), identifying those pregnancies requiring serial ultrasound scans. Many are concerned that this increased ultrasound scan demand will generate an unmanageable workload for the NHS. Methods We implemented a gap analysis; stillbirth audit; pilot study; pilot study audit; full guideline roll out. Gap analysis There are 4400 pregnancies at St Michael’s Hospital annually; 4.5% of all pregnancy-associated plasma protein A (PAPP-A) pregnancies are low <0.0415 multiples of the normal median (nine pregnancies/month). Of these, 80% already received serial scans. Low PAPP-A babies had lower birthweight and increased admission to neonatal intensive care unit (3.12 versus 3.42 kg, 6% versus 4%, respectively). Eighteen percent of pregnancies have minor/major risk factors and 80% of these already received serial scans. Stillbirth audit Of all stillbirths, 36% had autopsy evidence of FGR. All stillbirths had major/minor risk factors, but 42% did not receive serial scans. Pilot study audit Minor risk factors: 141 extra pregnancies to be scanned per year. Major risk factors: 244 extra pregnancies to be scanned per year, 60% are for low PAPP-A. Of low PAPP-A pregnancies (identified by antenatal screening co-ordinator), 13% developed FGR, all diagnosed antenatally. Guideline roll out Uterine artery assessment for three minor risk factors is inefficient. Instead, these pregnancies will receive serial growth scans. Low PAPP-A pregnancies will be scanned in the Fetal Medicine Unit. All other major/minor risk factor pregnancies will be scanned in the Ultrasound Department. Serial scans will occur at 28 and 36 weeks of gestation.

Database: EMBASE
Introduction Small-for-gestational-age (SGA) babies are at increased risk of perinatal morbidity and mortality, and antenatal detection may lead to improved outcomes. In trying to reduce the rate of undetected SGA, Warrington Hospital has implemented the Growth Assessment Protocol (GAP). We aimed to assess the impact of this on clinical practice and obstetric outcomes.

Methods All deliveries for a month were identified (n = 269). Information was collected for all term deliveries (>37 weeks) on the availability of customised growth charts in notes, indications for serial scans, gestation at birth, birthweight centile, detection of SGA (defined as birthweight <10th centile), intervention for delivery, mode of delivery and neonatal outcomes. Results In all, 238 deliveries at term were analysed; 149 had growth scans for indications according to GAP. Of these, 128 (53.7%) were classified high risk for serial scans, and 21 were referred after abnormal symphyseofundal height measurements (low risk). There were 23 SGA babies and 18 (78.3%) had antenatal growth scans. The SGA detection rate was 57.1% (8/14) in the high-risk group, 25% in the low-risk group, with an overall SGA detection of 39.1% (9/23). Growth scans failed to identify 50% of SGA. Of the women who had labour induced, 90.9% achieved a vaginal delivery. Neonatal outcome was good with two admissions to NICU. Conclusion Implementation of GAP has resulted in increased growth scans, and improved screening for SGA babies. The detection of SGA can be further improved by continued ultrasound scan surveillance until delivery, which has now been implemented. Intervention for SGA did not result in increased operative deliveries.

Database: EMBASE
9. Third-Trimester Fetal Biometry and Neonatal Outcomes in Term and Preterm Deliveries.

Author(s): Sheth, Tejas; Glantz, J Christopher

Source: Journal of ultrasound in medicine : official journal of the American Institute of Ultrasound in Medicine; Jan 2016; vol. 35 (no. 1); p. 103-110

Publication Date: Jan 2016

Publication Type(s): Journal Article

PubMedID: 26643756

Available at Journal of ultrasound in medicine : official journal of the American Institute of Ultrasound in Medicine - from HighWire - Free Full Text

Abstract: OBJECTIVES To determine whether specific biometric thresholds for head circumference, abdominal circumference, femur length, and estimated fetal weight can identify neonates at risk for adverse outcomes. METHODS We conducted a retrospective analysis of women with sonographic biometry after 26 weeks' gestational age (GA) followed by delivery of term and preterm neonates from 2007 through 2011. The head circumference, abdominal circumference, femur length, and estimated fetal weight were obtained. Sonographic data were merged with birth certificate and neonatal data. Biometry and estimated fetal weight were divided into percentile thresholds: 10th and above (reference), below 10th, below 5th, and below 3rd. Neonatal outcomes included neonatal intensive care unit admission, 5-minute Apgar score less than 7, and a composite of any morbidity/mortality (hypoxic-ischemic encephalopathy, periventricular leukomalacia, necrotizing enterocolitis, sepsis, renal failure, or death). Logistic regression yielded odds ratios and 95% confidence intervals for biometry and outcome, then adjusted for GA at delivery. RESULTS A total of 2237 patients delivered at term, and 455 delivered before term. Neonatal intensive care unit admission was not associated with any biometric threshold in the term and preterm groups. Five-minute Apgar score less than 7 was associated with head circumference below 10th, abdominal circumference below 3rd, and estimated fetal weight below 5th percentiles in the term group and head circumference below 10th, abdominal circumference below 10th, and femur length below 10th percentiles in the preterm group (P < .05). Composite morbidity/mortality was associated with abdominal circumference below 5th, femur length below 10th, and femur length below 3rd percentiles in the term group and head circumference below 5th, abdominal circumference below 10th, and femur length below 5th percentiles in the preterm group (P < .05). Adjustment for GA did not affect outcomes for term deliveries but did affect nearly all outcomes for preterm deliveries. CONCLUSIONS Irrespective of GA, no one biometric threshold can accurately predict adverse neonatal outcomes.

Database: Medline
10. Sonographic Detection and Clinical Importance of Growth Restriction in Pregnancies With Gastrochisis.

Author(s): Nelson, David B; Martin, Robert; Twickler, Diane M; Santiago-Munoz, Patricia C; McIntire, Donald D; Dashe, Jodi S

Source: Journal of ultrasound in medicine : official journal of the American Institute of Ultrasound in Medicine; Dec 2015; vol. 34 (no. 12); p. 2217-2223

Publication Date: Dec 2015
Publication Type(s): Journal Article
PubMedID: 26518276
Available at Journal of Ultrasound in Medicine - from HighWire - Free Full Text

Abstract: OBJECTIVES The purpose of this study was to estimate the utility of sonography to detect small-for-gestational-age (SGA) neonates in pregnancies with gastrochisis and to evaluate neonatal outcomes according to birth weight percentile. METHODS We conducted a retrospective cohort study of singleton pregnancies with fetal gastrochisis delivered at our hospital between August 1997 and December 2012. Diagnosis of growth restriction was based on estimated fetal weight below the 10th percentile using the nomogram of Hadlock et al (Am J Obstet Gynecol 1985; 151:333-337), evaluated at 4-week intervals throughout gestation and compared with subsequent birth weight, to evaluate the accuracy of sonography to detect and exclude SGA neonates. Pregnancy and neonatal outcomes were evaluated according to birth weight percentile. RESULTS There were 111 births with gastrochisis (6 per 10,000), and one-third (n = 37) had birth weight below the 10th percentile. The sensitivity and negative predictive value of sonography for an SGA neonate both approached 90% by 32 weeks and were approximately 95% thereafter. Detection increased with advancing gestational age (P = .02). The birth weight percentile was not associated with preterm birth, infection, bowel complications requiring surgery, duration of hospitalization, or perinatal mortality. Delayed closure of the gastrochisis defect was more frequent with birth weights at or below the 3rd percentile (P = .03). CONCLUSIONS Sonography reliably identified SGA neonates with gastrochisis in our series, and its utility improved with advancing gestation. Apart from delayed closure of the defect, a low birth weight percentile was not associated with an increased risk of morbidity or mortality in the immediate neonatal period.

Database: Medline
11. Dichorionic twin ultrasound surveillance: sonography every 4 weeks significantly underperforms sonography every 2 weeks: results of the Prospective Multicenter ESPRiT Study.

Author(s): Corcoran, Siobhan; Breathnach, Fionnuala; Burke, Gerard; McAuliffe, Fionnuala; Geary, Michael; Daly, Sean; Higgins, John; Hunter, Alyson; Morrison, John J; Higgins, Shane; Mahony, Rhona; Dicker, Patrick; Tully, Elizabeth; Malone, Fergal D

Source: American journal of obstetrics and gynecology; Oct 2015; vol. 213 (no. 4); p. 551

Publication Date: Oct 2015

Publication Type(s): Research Support, Non-u.s. Gov't Multicenter Study Journal Article

PubMedID: 26259909

Abstract: OBJECTIVE A 2-week ultrasound scanning schedule for monochorionic twins is endorsed widely. There is a lack of robust data to inform a schedule for the surveillance of dichorionic gestations. We aimed to determine how ultrasound scanning that is performed at 2- or 4-week intervals (or every 4 weeks before 32 weeks' gestation and every 2 weeks thereafter) may impact the prenatal detection of fetal growth restriction (FGR) and ultimately influence timing of delivery. STUDY DESIGN In a consecutive cohort of 789 dichorionic twin pregnancies that were recruited prospectively for the multicenter Evaluation of Sonographic Predictors of Restricted Growth in Twins study, ultrasound determination of fetal growth and interrogation of umbilical and middle cerebral artery Doppler scans were performed every 2 weeks from 24 weeks' gestation until delivery. Complete delivery and perinatal outcome data were recorded for all pregnancies. Where delivery was prompted by FGR, abnormal umbilical artery Doppler examination or poor biophysical profile and in the absence of ruptured membranes, onset of labor, preeclampsia, or antepartum hemorrhage, the delivery was considered "ultrasound-indicated." For ultrasound-indicated deliveries, detection probabilities for FGR/abnormal umbilical artery Doppler scans/poor biophysical profile were determined according to the interval between examinations, by the suppression of alternate examination data. RESULTS Among 789 dichorionic twin pregnancies, 66 pairs (8%) had an "ultrasound indicated" delivery. Detection of FGR was reduced from 88-69%, and detection of abnormal umbilical artery Doppler was reduced from 82-62% when a 4-week ultrasound schedule was simulated. Both of these reductions reached statistical significance. There was a nonsignificant trend toward a reduction in the recording of oligohydramnios with a 4-week interval between examinations. CONCLUSION This study suggests that the ultrasound surveillance program of every 2 weeks that is recommended currently for monochorionic twins should be extended to dichorionic gestations.

Database: Medline

**Authors:** Vayssière, C; Sentilhes, L; Ego, A; Bernard, C; Cambourieu, D; Flamant, C; Gascoin, G; Gaudineau, A; Grangé, G; Houfflin-Debarge, V; Langer, B; Malan, V; Marcorelles, P; Nizard, J; Perrotin, F; Salomon, L; Senat, M-V; Serry, A; Tessier, V; Truffert, P; Tsatsaris, V; Arnaud, C; Caronne, B

**Source:** European journal of obstetrics, gynecology, and reproductive biology; Oct 2015; vol. 193; p. 10-18

**Publication Date:** Oct 2015

**Publication Type(s):** Practice Guideline Journal Article

**PubMedID:** 26207980

**Abstract:** Small for gestational age (SGA) is defined by weight (in utero estimated fetal weight or birth weight) below the 10th percentile (professional consensus). Severe SGA is SGA below the third percentile (professional consensus). Fetal growth restriction (FGR) or intra-uterine growth restriction (IUGR) usually correspond with SGA associated with evidence indicating abnormal growth (with or without abnormal uterine and/or umbilical Doppler): arrest of growth or a shift in its rate measured longitudinally (at least two measurements, 3 weeks apart) (professional consensus). More rarely, they may correspond with inadequate growth, with weight near the 10th percentile without being SGA (LE2). Birthweight curves are not appropriate for the identification of SGA at early gestational ages because of the disorders associated with preterm delivery. In utero curves represent physiological growth more reliably (LE2). In diagnostic (or reference) ultrasound, the use of growth curves adjusted for maternal height and weight, parity and fetal sex is recommended (professional consensus). In screening, the use of adjusted curves must be assessed in pilot regions to determine the schedule for their subsequent introduction at national level. This choice is based on evidence of feasibility and the absence of any proven benefits for individualized curves for perinatal health in the general population (professional consensus). Children born with FGR or SGA have a higher risk of minor cognitive deficits, school problems and metabolic syndrome in adulthood. The role of preterm delivery in these complications is linked. The measurement of fundal height remains relevant to screening after 22 weeks of gestation (Grade C). The biometric ultrasound indicators recommended are: head circumference (HC), abdominal circumference (AC) and femur length (FL) (professional consensus). They allow calculation of estimated fetal weight (EFW), which, with AC, is the most relevant indicator for screening. Hadlock’s EFW formula with three indicators (HC, AC and FL) should ideally be used (Grade B). The ultrasound report must specify the percentile of the EFW (Grade C). Verification of the date of conception is essential. It is based on the crown-rump length between 11 and 14 weeks of gestation (Grade A). The HC, AC and FL measurements must be related to the appropriate reference curves (professional consensus); those modelled from College Francais d’Echographie Fetale data are recommended because they are multicentere French curves (professional consensus). Whether or not a work-up should be performed and its content depend on the context (gestational age, severity of biometric abnormalities, other ultrasound data, parents’ wishes, etc.) (professional consensus). Such a work-up only makes sense if it might modify pregnancy management and, in particular, if it has the potential to reduce perinatal and long-term morbidity and mortality (professional consensus). The use of umbilical artery Doppler velocimetry is associated with better newborn health status in populations at risk, especially in those with FGR (Grade A). This Doppler examination must be the first-line tool for surveillance of fetuses with SGA and FGR (professional consensus). A course of corticosteroids is recommended for women with an FGR fetus, and for whom delivery before 34 weeks of gestation is envisaged (Grade C). Magnesium sulphate should be prescribed for preterm deliveries before 32-33 weeks of gestation (Grade A). The same management should apply for preterm FGR deliveries (Grade C). In cases of FGR, fetal growth must be monitored at intervals of no less than 2 weeks, and ideally 3 weeks (professional consensus). Referral to a Level IIb or III maternity ward must be proposed in cases of EFW <1500g, potential birth
before 32-34 weeks of gestation (absent or reversed umbilical end-diastolic flow, abnormal venous Doppler) or a fetal disease associated with any of these (professional consensus). Systematic caesarean deliveries for FGR are not recommended (Grade C). In cases of vaginal delivery, fetal heart rate must be monitored continuously during labour, and any delay before intervention must be faster than in low-risk situations (professional consensus). Regional anaesthesia is preferred in trials of vaginal delivery, as in planned caesareans. Morbidity and mortality are higher in SGA newborns than in normal-weight newborns of the same gestational age (LE3). The risk of neonatal mortality is two to four times higher in SGA newborns than in non-SGA preterm and full-term infants (LE2).

Initial management of an SGA newborn includes combatting hypothermia by maintaining the heat chain (survival blanket), ventilation with a pressure-controlled insufflator, if necessary, and close monitoring of capillary blood glucose (professional consensus). Testing for antiphospholipids (anticardiolipin, circulating anticoagulant, anti-beta2-GP1) is recommended in women with previous severe FGR (below third percentile) that led to birth before 34 weeks of gestation (professional consensus). It is recommended that aspirin should be prescribed to women with a history of pre-eclampsia before 34 weeks of gestation, and/or FGR below the fifth percentile with a probable vascular origin (professional consensus). Aspirin must be taken in the evening or at least 8h after awakening (Grade B), before 16 weeks of gestation, at a dose of 100-160mg/day (Grade A).

Database: Medline


Author(s): Seravalli, Viola; Baschat, Ahmet A

Source: Obstetrics and gynecology clinics of North America; Jun 2015; vol. 42 (no. 2); p. 275-288

Publication Date: Jun 2015

Publication Type(s): Journal Article Review

PubMedID: 26002166

Abstract:A uniform approach to the diagnosis and management of fetal growth restriction (FGR) consistently produces better outcome, prevention of unanticipated stillbirth, and appropriate timing of delivery. Early-onset and late-onset FGR represent two distinct clinical phenotypes of placental dysfunction. Management challenges in early-onset FGR revolve around prematurity and coexisting maternal hypertensive disease, whereas in late-onset disease failure of diagnosis or surveillance leading to unanticipated stillbirth is the primary issue. Identifying the surveillance tests that have the highest predictive accuracy for fetal acidemia and establishing the appropriate monitoring interval to detect fetal deterioration is a high priority.

Database: Medline
14. Prediction of small-for-gestational-age neonates: screening by fetal biometry at 35-37 weeks

**Author(s):** Fadigas C.; Said Y.; Gonzalez R.; Poon L.C.; Nicolaides K.H.

**Source:** Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology; May 2015; vol. 45 (no. 5); p. 559-565

**Publication Date:** May 2015

**Publication Type(s):** Article

**PubMedID:** 25728139

Available at Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology - from Wiley Online Library Science, Technology and Medicine Collection 2017

Available at Ultrasound in obstetrics & gynecology : the official journal of the International Society of Ultrasound in Obstetrics and Gynecology - from Unpaywall

**Abstract:**

**OBJECTIVE:** To investigate the value of fetal biometry at 35-37 weeks' gestation in the prediction of delivery of small-for-gestational-age (SGA) neonates, in the absence of pre-eclampsia (PE).

**METHODS:** This was a screening study in singleton pregnancies at 35-37 weeks' gestation, comprising 278 that delivered SGA neonates with a birth weight < 5th percentile and 5237 cases unaffected by SGA, PE or gestational hypertension. Multivariable logistic regression analysis was used to determine if screening by a combination of maternal factors and Z-scores of fetal head circumference (HC), abdominal circumference (AC) and femur length (FL) or estimated fetal weight (EFW) had a significant contribution to the prediction of SGA neonates.

**RESULTS:** Multivariable logistic regression analysis demonstrated that the likelihood of delivering a SGA neonate with a birth weight < 5th percentile decreased with maternal weight and height, and in parous women the risk increased with a longer interpregnancy interval. The risk was higher in women of Afro-Caribbean and South Asian racial origins, in cigarette smokers, nulliparous women and in those with history of SGA, with or without prior PE. Combined screening by maternal characteristics and history with EFW Z-scores at 35-37 weeks predicted 89% of SGA neonates with birth weight < 5th percentile delivering < 2 weeks following assessment, at a 10% false-positive rate (FPR). The respective detection rate for the prediction of SGA neonates delivering >= 37 weeks' gestation was 70%. The performance of screening by a combination of Z-scores of fetal HC, AC and FL was similar to that achieved by the EFW Z-score.

**CONCLUSION:** Combined testing by maternal characteristics and fetal biometry at 35-37 weeks could identify, at a 10% FPR, about 90% of pregnancies that subsequently deliver SGA neonates within 2 weeks of assessment and 70% of those that deliver >= 37 weeks.

**Database:** EMBASE
15. Update on the diagnosis and classification of fetal growth restriction and proposal of a stage-based management protocol.

**Author(s):** Figueras, Francesc; Gratacós, Eduard

**Source:** Fetal diagnosis and therapy; 2014; vol. 36 (no. 2); p. 86-98

**Publication Date:** 2014

**Publication Type(s):** Journal Article Review

**PubMedID:** 24457811

**Abstract:** Small fetuses are defined as those with an ultrasound estimated weight below a threshold, most commonly the 10th centile. The first clinically relevant step is the distinction of 'true' fetal growth restriction (FGR), associated with signs of abnormal fetoplacental function and poorer perinatal outcome, from constitutional small-for-gestational age, with a near-normal perinatal outcome. Nowadays such a distinction should not be based solely on umbilical artery Doppler, since this index detects only early-onset severe forms. FGR should be diagnosed in the presence of any of the factors associated with a poorer perinatal outcome, including Doppler cerebroplacental ratio, uterine artery Doppler, a growth centile below the 3rd centile, and, possibly in the near future, maternal angiogenic factors. Once the diagnosis is established, differentiating into early- and late-onset FGR is useful mainly for research purposes, because it distinguishes two clear phenotypes with differences in severity, association with preeclampsia, and the natural history of fetal deterioration. As a second clinically relevant step, management of FGR and the decision to deliver aims at an optimal balance between minimizing fetal injury or death versus the risks of iatrogenic preterm delivery. We propose a protocol that integrates current evidence to classify stages of fetal deterioration and establishes follow-up intervals and optimal delivery timings, which may facilitate decisions and reduce practice variability in this complex clinical condition.

**Database:** Medline

16. Effect of serial scan frequency on antenatal detection of fetal growth restriction

**Author(s):** Southam M.; Williams M.; Malik A.; Gardosi J.

**Source:** Archives of Disease in Childhood: Fetal and Neonatal Edition; Jun 2014; vol. 99

**Publication Date:** Jun 2014

**Publication Type(s):** Conference Abstract

**Abstract:** Objective Previous delivery of a small for gestational age (SGA) baby is an accepted indication for increased surveillance in subsequent pregnancies. We sought to quantify the effectiveness of the various serial scan protocols which were in operation in our NHS Region. Method The cohort consisted of 5281 singleton, normally formed pregnancies with a past history of one or more SGA births. Cases were categorised according to the number of serial scans planned at the beginning of pregnancy, with scans done as follow up after first detection of SGA not counted. Birthweight was defined as <10th customised centile, and antenatal detection was based on one or more ultrasound estimated fetal weights (EFW) recorded as below the 10th centile. Results The SGA rate in this group was 29.4%. The table shows the respective frequencies of various scan policies and detection rate if the birthweight was SGA. Conclusion Antenatal SGA detection rate is proportional to the number of investigations offered, and increases substantially with scans done at term. Performance of 1 or 2 scans seems no better than doing no scans at all. These findings raise doubt about the utility of routine growth scans proposed for all pregnancies. (Table Presented).
17. Fetal growth restriction and the risk of perinatal mortality-case studies from the multicentre PORTO study.

Author(s): Unterscheider, Julia; O'Donoghue, Keelin; Daly, Sean; Geary, Michael P; Kennelly, Mairead M; McAuliffe, Fionnuala M; Hunter, Alyson; Morrison, John J; Burke, Gerard; Dicker, Patrick; Tully, Elizabeth C; Malone, Fergal D

Source: BMC pregnancy and childbirth; Feb 2014; vol. 14; p. 63

Publication Date: Feb 2014

Publication Type(s): Multicenter Study Journal Article Observational Study

PubMedID: 24517273

Abstract:BACKGROUND Intrauterine growth restriction (IUGR) is the single largest contributing factor to perinatal mortality in non-anomalous fetuses. Advances in antenatal and neonatal critical care have resulted in a reduction in neonatal deaths over the past decades, while stillbirth rates have remained unchanged. Antenatal detection rates of fetal growth failure are low, and these pregnancies carry a high risk of perinatal death.

METHOD The Prospective Observational Trial to Optimize Paediatric Health in IUGR (PORTO) Study recruited 1,200 ultrasound-dated singleton IUGR pregnancies, defined as EFW <10th centile, between 24+0 and 36+6 weeks gestation. All recruited fetuses underwent serial sonographic assessment of fetal weight and multi-vessel Doppler studies until birth. Perinatal outcomes were recorded for all pregnancies. Case records of the perinatal deaths from this prospectively recruited IUGR cohort were reviewed, their pregnancy details and outcome were analysed descriptively and compared to the entire cohort.

RESULTSOF 1,116 non-anomalous singleton infants with EFW <10th centile, 6 resulted in perinatal deaths including 3 stillbirths and 3 early neonatal deaths. Perinatal deaths occurred between 24+6 and 35+0 weeks gestation corresponding to birthweights ranging from 460 to 2260 grams. Perinatal deaths occurred more commonly in pregnancies with severe growth restriction (EFW <3rd centile) and associated abnormal Doppler findings resulting in earlier gestational ages at delivery and lower birthweights. All of the described pregnancies were complicated by either significant maternal comorbidities, e.g. hypertension, systemic lupus erythematosus (SLE) or diabetes, or poor obstetric histories, e.g. prior perinatal death, mid-trimester or recurrent pregnancy loss. Five of the 6 mortalities occurred in women of non-Irish ethnic backgrounds. All perinatal deaths showed abnormalities on placental histopathological evaluation.

CONCLUSION The PNMR in this cohort of prenatally identified IUGR cases was 5.4/1,000 and compares favourably to the overall national rate of 4.1/1,000 births, which can be attributed to increased surveillance and timely delivery. Despite antenatal recognition of IUGR and associated maternal risk factors, not all perinatal deaths can be prevented.
18. Level 1 evidence for the diagnostic effectiveness of routine sonography as a screening test for small for gestational age (SGA) infants

Author(s): Sovio U.; Smith G.; Dacey A.

Source: American Journal of Obstetrics and Gynecology; Jan 2014; vol. 210 (no. 1)

Publication Date: Jan 2014

Publication Type(s): Conference Abstract

Abstract: OBJECTIVE: Antenatal detection of SGA infants has the potential to inform multiple aspects of care, but a meta-analysis including 27,000 women demonstrated no beneficial effect of routine screening using third trimester sonography. However, a detailed review (NICE, UK) concluded that the trials were designed in the absence of Level 1 evidence of the diagnostic effectiveness of screening using routine sonography and recommended further prospective studies. STUDY DESIGN: We conducted a prospective cohort study of unselected nulliparous women attending for prenatal care in Cambridge (UK) between Jan 2008 and Jul 2012. All women had screening fetal biometry performed at 28 and 36 weeks gestational age and these results were blinded, as required for Level 1 evidence of diagnostic effectiveness. Standard clinical care involved selection of women for sonograms in the third trimester on the basis of risk factors and serial symphyseal-fundal height measurements, and these results were reported. SGA was defined as birth weight percentile <10th for sex and gestational age, and severe SGA was defined as <3rd percentile. A positive prenatal diagnosis was defined as an estimated fetal weight (EFW) <10th percentile at the last sonogram performed prior to birth (using Hadlock equations and percentiles). RESULTS: Among 4,006 women with screening and outcome data, 352 (9%) infants were SGA and 85 (2%) were severe SGA. 1,696 (42%) women had one or more clinically indicated sonograms at or after 26 weeks gestational age. The sensitivity of standard care (selective sonography) was 20% for SGA and 32% for severe SGA (Table). The sensitivity of screening sonography was more than double that of selective sonography: 57% for SGA and 79% for severe SGA (both P<0.001 compared with selective sonography). The areas under the receiver operating characteristic (ROC) curve for screening EFW percentile were 0.87 for SGA and 0.92 for severe SGA. CONCLUSION: Routine sonography at 28 and 36 weeks performs well as a screening test to detect SGA infants in a population of unselected nulliparous women (Level 1 evidence of diagnostic effectiveness). (Table presented).

Database: EMBASE
19. A randomized controlled trial of third-trimester routine ultrasound in a non-selected population

Author(s): Skrastad R.B.; Eik-Nes S.H.; Salvesen K.A.; Romundstad P.R.; Blaas H.-G.K.; Sviggum O.; Johansen O.J.

Source: Acta Obstetricia et Gynecologica Scandinavica; Dec 2013; vol. 92 (no. 12); p. 1353-1360

Publication Date: Dec 2013

Publication Type(s): Article

PubMedID: 24032741

Abstract: Objective To compare detection rates of small-for-gestational-age fetuses, large-for-gestational-age fetuses, congenital anomalies and adverse perinatal outcomes in pregnancies randomized to third-trimester routine ultrasound or ultrasound on clinical indication. Design Randomized controlled trial. Setting National Center for Fetal Medicine in Norway between 1989 and 1992. Population A total of 6780 pregnancies from a non-selected population. Methods Two routine ultrasound examinations at 18 and 33 weeks were compared with routine ultrasound at 18 weeks and ultrasound on clinical indication. Suspected small-for-gestational-age fetuses were followed with serial scans and cardiotocography. Doppler ultrasound was not used. Main outcome measures Detection rates of small-for-gestational-age and large-for-gestational-age fetuses, congenital anomalies and adverse perinatal outcomes. Results Third trimester routine ultrasound improved detection rates of small-for-gestational-age fetuses from 46 to 80%, but overall perinatal morbidity and mortality remained unchanged. Detection of large-for-gestational-age fetuses increased from 36 to 91%. There was a significant increase of induction of labor and elective cesarean sections due to suspected small-for-gestational-age and a significant decrease of induction of labor and elective cesarean sections due to suspected large-for-gestational-age in the study group; there were no other differences regarding intervention. The detection rate of congenital anomalies was 56%, with no significant difference between the groups. Conclusions Routine use of third-trimester routine ultrasound increased detection rates of small-for-gestational-age and large-for-gestational-age fetuses. This did not alter perinatal outcomes. Third-trimester ultrasound screening should not be rejected before a policy of adding Doppler surveillance to the high-risk group identified has been investigated further. © 2013 Nordic Federation of Societies of Obstetrics and Gynecology.

Database: EMBASE

Author(s): American College of Obstetricians and Gynecologists

Source: Obstetrics and gynecology; May 2013; vol. 121 (no. 5); p. 1122-1133

Publication Date: May 2013

Publication Type(s): Practice Guideline Journal Article

PubMedID: 23635765

Available at Obstetrics and gynecology - from Free Medical Journals . com
Available at Obstetrics and gynecology - from Ovid (Journals @ Ovid) - Remote Access

Abstract: Fetal growth restriction, also known as intrauterine growth restriction, is a common complication of pregnancy that has been associated with a variety of adverse perinatal outcomes. There is a lack of consensus regarding terminology, etiology, and diagnostic criteria for fetal growth restriction, with uncertainty surrounding the optimal management and timing of delivery for the growth-restricted fetus. An additional challenge is the difficulty in differentiating between the fetus that is constitutionally small and fulfilling its growth potential and the small fetus that is not fulfilling its growth potential because of an underlying pathologic condition. The purpose of this document is to review the topic of fetal growth restriction with a focus on terminology, etiology, diagnostic and surveillance tools, and guidance for management and timing of delivery.

Database: Medline

21. Regimens of fetal surveillance for impaired fetal growth

Author(s): Grivell R.M.; Wong L.; Bhatia V.

Source: Cochrane database of systematic reviews (Online); 2012; vol. 6

Publication Date: 2012

Publication Type(s): Review

PubMedID: 22696366

Available at The Cochrane database of systematic reviews - from Cochrane Collaboration (Wiley)

Abstract: Policies and protocols for fetal surveillance in the pregnancy where impaired fetal growth is suspected vary widely, with numerous combinations of different surveillance methods. To assess the effects of antenatal fetal surveillance regimens on important perinatal and maternal outcomes. We searched the Cochrane Pregnancy and Childbirth Group’s Trials Register (29 February 2012). Randomised and quasi-randomised trials comparing the effects of described antenatal fetal surveillance regimens. Review authors R Grivell and L Wong independently assessed trial eligibility and extracted data. We included one trial of 167 women and their babies. This trial was a pilot study recruiting alongside another study, therefore, a separate sample size was not calculated. The trial compared a twice-weekly surveillance regimen (biophysical profile, nonstress tests, umbilical artery and middle cerebral artery Doppler and uterine artery Doppler) with the same regimen applied fortnightly (both groups had growth assessed fortnightly). There were insufficient data to assess this review's primary infant outcome of composite perinatal mortality and serious morbidity (although there were no perinatal deaths) and no difference was seen in the primary maternal outcome of emergency caesarean section for fetal distress (risk ratio (RR) 0.96; 95% confidence interval (CI) 0.35 to 2.63). In keeping with the more frequent monitoring, mean gestational age at birth was four days less for the twice-weekly surveillance group compared with the fortnightly surveillance group (mean difference (MD) -4.00; 95% CI -7.79 to -0.21). Women in the twice-weekly surveillance group were 25% more likely to have induction of labour than those in the fortnightly surveillance group (RR 1.25; 95% CI 1.04 to 1.50). There is limited evidence from randomised controlled trials to inform best practice for fetal surveillance regimens when caring for
women with pregnancies affected by impaired fetal growth. More studies are needed to evaluate the effects of currently used fetal surveillance regimens in impaired fetal growth.

Database: EMBASE

22. Fetal growth restriction - from observation to intervention.

Author(s): Baschat, Ahmet Alexander

Source: Journal of perinatal medicine; May 2010; vol. 38 (no. 3); p. 239-246

Publication Date: May 2010

Publication Type(s): Journal Article Review

PubMedID: 20205623

Abstract: Fetal growth restriction (FGR) due to placental dysfunction has important short- and long-term impacts that may reach into adulthood. Early-onset FGR before 34 weeks' gestation shows a characteristic sequence of responses to placental dysfunction that evolves from the arterial circulation to the venous system and finally to biophysical abnormalities. In this form of FGR safe prolongation of pregnancy is a primary management goal, as gestational age at delivery, birth weight and iatrogenic premature delivery have an important impact on short-term outcome and neurodevelopment. Surveillance intervals should be adjusted based on umbilical artery and venous Doppler studies. Intervention thresholds need to be based on the balance of fetal vs. neonatal risks and therefore critically depend on gestational age. Late-onset FGR presents with subtle Doppler and biophysical abnormalities and therefore poses a diagnostic dilemma. Often unrecognized, term FGR contributes to a large proportion of adverse perinatal outcome. Monitoring intervals should be adjusted based on middle cerebral artery Doppler and fetal heart rate parameters. Delivery timing thresholds can be low. In both forms of FGR neurodevelopmental impacts of placental disease occur before clinical decisions regarding delivery timing arise. This places special emphasis on future preventative studies.

Database: Medline
23. Fetal growth restriction.

**Author(s):** Miller, Jena; Turan, Sifa; Baschat, Ahmet A  
**Source:** Seminars in perinatology; Aug 2008; vol. 32 (no. 4); p. 274-280  
**Publication Date:** Aug 2008  
**Publication Type(s):** Journal Article Review  
**PubMedID:** 18652928

**Abstract:** Normal fetal growth is determined by the genetically predetermined growth potential and further modulated by maternal, fetal, placental, and external factors. Fetal growth restriction (FGR) is a failure to reach this potential and is clinically suspected if sonographic estimates of fetal weight, size, or symmetry are abnormal. Integration of fetal anatomy assessment, amniotic fluid dynamics, uterine, umbilical, and fetal middle cerebral artery Doppler is the most effective approach to differentiate potentially manageable placenta-based FGR from aneuploidy, nonaneuploid syndromes, and viral infection. Although placental dysfunction results in a multisystem fetal syndrome with impacts on short- and long-term outcome, only cardiovascular and behavioral responses are helpful to guide surveillance and intervention. Early-onset FGR before 34 weeks gestation is readily recognized but challenging to manage as questions about optimal delivery timing remain unanswered. In contrast, near-term FGR provides less of a management challenge but is often missed as clinical findings are more subtle. Once placenta-based FGR is diagnosed, integrating multivessel Doppler and biophysical profile score provides information on longitudinal progression of placental dysfunction and degree of fetal acidemia, respectively. Choosing appropriate monitoring intervals based on anticipated disease acceleration and intervention when fetal risks exceed neonatal risks are the prevailing current management approaches.

**Database:** Medline


**Author(s):** Wiegand, Samantha; McKenna, David S; Croom, Christopher; Ventolini, Gary; Sonek, Jiri D; Neiger, Ran  
**Source:** American journal of perinatology; Mar 2008; vol. 25 (no. 3); p. 149-152  
**Publication Date:** Mar 2008  
**Publication Type(s):** Journal Article Validation Studies  
**PubMedID:** 18297613

**Abstract:** Pregnancies complicated by an isolated single umbilical artery (SUA) are thought to be at increased risk for intrauterine growth restriction (IUGR). The management of these pregnancies often includes serial sonographic assessments of fetal growth. The goal of our study was to test the validity of this assertion. We conducted a longitudinal sonographic assessment of intrauterine fetal growth in pregnancies complicated by a SUA. We included pregnancies where fetal growth was assessed three or more times, and the presence of SUA was repeatedly demonstrated. Pregnancies with fetal anomalies and multiple gestations were excluded. IUGR was defined as an estimated fetal weight (EFW) < or = 10th percentile of the normal ranges established by Hadlock. Between January 1999 and December 2005, we identified 273 pregnancies with SUA, for an overall incidence of 0.48% within the total population of patients examined at our institution. One hundred and thirty-five pregnancies did not meet our inclusion criteria. Of the 138 we analyzed, four pregnancies (2.9%) were found to have EFW < or = 10th percentile. We concluded that the occurrence of IUGR in pregnancies complicated by an isolated SUA is not increased. Serial sonographic assessments of fetal growth do not appear to be indicated in the management of such pregnancies.
25. Use of serial ultrasound to identify periods of fetal growth restriction in relation to neonatal anthropometry.

Author(s): Hemachandra, Anusha H; Klebanoff, Mark A

Source: American journal of human biology : the official journal of the Human Biology Council; 2006; vol. 18 (no. 6); p. 791-797

Publication Date: 2006

Publication Type(s): Research Support, N.i.h., Intramural Multicenter Study Journal Article

PubMedID: 17039476

Available at American journal of human biology : the official journal of the Human Biology Council - from Wiley Online Library Science, Technology and Medicine Collection 2017

Abstract: The developmental origins of the health and disease hypothesis suggests that fetal growth restriction (FGR) is a risk factor for several chronic diseases of adulthood. However, most supporting studies use birth weight as a proxy measure of FGR. To examine the relationship between birth weight and FGR, the present study used serial prenatal ultrasound to identify periods of FGR during gestation, and related these periods to birth size and shape. The data in this study included serial prenatal ultrasounds performed on 1,349 high-risk Scandinavian women enrolled in the National Institute of Child Health and Human Development Study of Successive Small for Gestational Age Births. Fetal growth velocity between ultrasounds was used to identify periods of isolated FGR, and these were studied in relation to anthropometry at birth. FGR was identified in 184 subjects. A control group of 384 subjects without FGR was also identified. Infants with first-trimester FGR (n = 20) had the highest birth weight, ponderal index, and subscapular skinfold thickness. Infants with second-trimester FGR (n = 37) had the highest arm fat percentage. Infants with early third-trimester FGR (n = 55) had the lowest mean birth weight and ponderal index. When infant gender, gestational age, maternal body mass index, and smoking were controlled, birth weight was predicted only by third-trimester FGR (not first- or second-trimester FGR), and arm fat percent was predicted only by second-trimester FGR. These results suggest that birth weight is not a valid indicator of FGR occurring before the third trimester. Body composition may be a more sensitive marker of early FGR.

Database: Medline

**Author(s):** Owen, P; Maharaj, S; Khan, K S; Howie, P W

**Source:** Obstetrics and gynecology; Apr 2001; vol. 97 (no. 4); p. 499-504

**Publication Date:** Apr 2001

**Publication Type(s):** Research Support, Non-u.s. Gov't Journal Article

**PubMedID:** 11275017

Available at Obstetrics and gynecology - from Free Medical Journals . com

Available at Obstetrics and gynecology - from Ovid (LWW Total Access Collection 2015 - Q1 with Neurology)

**Abstract:**

**OBJECTIVE**

To determine the influence of the interval between fetal measurements on performance of fetal growth velocity for predicting infants with anthropometric features of fetal growth restriction (FGR).

**METHOD**

Two hundred seventy-four low-risk women had serial fetal biometry at scheduled intervals. Growth velocity of the fetal abdominal area for each was calculated with 2-, 4-, and 6-week scan intervals in which the second measurement was the last scan before delivery. Fetal abdominal area velocity over a 4-week interval in the early third trimester also was included. Fetal growth restriction was defined as skinfold thickness under the tenth percentile, ponderal index under the 25th percentile, midarm circumference-to-occipitofrontal circumference ratio of under -1 standard deviation (SD). Test performance was expressed as likelihood ratios with 95% confidence intervals (CI).

**RESULTS**

Fetal abdominal area velocity calculated over a 4-week interval predicted FGR with a likelihood ratio of 10.4 (95% CI 3.9, 26) for skinfold thickness; 9.5 (95% CI 4.6, 19) for ponderal index; and 4.7 (2.3, 8.4) for midarm circumference-to-occipitofrontal circumference ratio. Intermeasurement intervals of 6 weeks had a likelihood ratio of 8.5 (95% CI 4, 17) for skinfold thickness; 7.5 (95% CI 3.4, 16.1) for ponderal index; and 14 (6.7, 28) for midarm circumference-to-occipitofrontal circumference ratio. The likelihood ratios for the 2-week interval and the early third trimester 4-week interval were all less than 5.

**CONCLUSION**

Four- and 6-week measurement intervals were useful for predicting infants with FGR and were superior to a 2-week interval. Fetal growth velocity is influenced by proximity of the last fetal measurement to date of delivery, which adversely affects clinical use of growth velocity for predicting FGR.

**Database:** Medline
27. Serial measurements of serum human placental lactogen (hPL) and serial ultrasound examinations in the evaluation of fetal growth.

**Author(s):** Sørensen, S; von Tabouillot, D; Schioler, V; Greisen, G; Petersen, S; Larsen, T

**Source:** Early human development; Nov 2000; vol. 60 (no. 1); p. 25-34

**Publication Date:** Nov 2000

**Publication Type(s):** Journal Article

**PubMedID:** 11054581

**Abstract:** Serial serum hPL measurements and serial ultrasound fetometry were compared in the evaluation of fetal growth by relating these two parameters to size at birth and to clinical factors known to influence size at birth. The data were from a prospective study of 1000 consecutive pregnant women considered to be at risk for fetal growth retardation with retrospective analysis. Serum hPL was measured by radioimmunoassay and fetal weight estimated by ultrasound every 3 weeks during the last trimester. hPL values were expressed as multiples of the median (MoM) and linear regression analysis of the hPL MoM values was carried out for each pregnancy to find the slope of the line (hPL-slope); at least 3 serum hPL values were required. The estimated fetal weight and weight-for-age at birth was expressed in Z-scores. The individual intrauterine growth velocity was calculated by regression analysis and expressed as change in Z-score for 12 weeks. At least two ultrasound measurements over an interval of at least 42 days were used to estimate the fetal growth velocity. In 588 women the file was complete. The main outcome measures were the individual mean hPL, hPL-slope, fetal growth velocity, birth weight deviation, smoking in pregnancy and diagnosis of preeclampsia. A significant correlation was found between the hPL-slope and the intrauterine fetal growth velocity (r=0.34), and between hPL-slope and birth weight deviation (r=0.32). Mean hPL was correlated to birth weight deviation (r=0.27), but only very weakly to intrauterine growth velocity (r=0.08). hPL-slope and intrauterine growth velocity independently predicted birth weight deviation. Heavy smoking which was stopped before the third trimester was not associated with low intrauterine growth velocity, but with a low hPL-slope. Preeclampsia was associated with a trend towards low and decreasing hPL and with an increasing intrauterine growth velocity and birth weight deviation. In conclusion the rate of change of serial hPL measurements correlated well to intrauterine fetal growth velocity in the third trimester as estimated by ultrasound and to the deviation in birth weight, but hPL seems to have a separate physiological significance, since it did not pick up when smoking was stopped and growth velocity was normalised and it did not at all detect the increased growth associated with preeclampsia.

**Database:** Medline
28. A pilot randomized controlled trial of two regimens of fetal surveillance for small-for-gestational-age fetuses with normal results of umbilical artery doppler velocimetry.

Author(s): McCowan, L M; Harding, J E; Roberts, A B; Barker, S E; Ford, C; Stewart, A W

Source: American journal of obstetrics and gynecology; Jan 2000; vol. 182 (no. 1); p. 81-86

Publication Date: Jan 2000

Publication Type(s): Research Support, Non-u.s. Gov't Randomized Controlled Trial Clinical Trial Journal Article

PubMedID: 10649160

Abstract: OBJECTIVE This study was undertaken to determine whether the frequency of fetal surveillance could be safely reduced from twice weekly to fortnightly in the case of small-for-gestational-age fetuses with normal results of umbilical artery Doppler velocimetry studies. STUDY DESIGN Pregnant women between 24 and 36 weeks' gestation (n = 167) with small-for-gestational-age fetuses and normal results of umbilical artery Doppler velocimetry studies were randomly allocated to undergo twice-weekly or fortnightly fetal surveillance. Statistical analysis was carried out according to intention to treat. RESULTSEighty-five women were randomly assigned to undergo twice-weekly fetal surveillance and 82 were randomly assigned to undergo fortnightly fetal surveillance. Those randomly assigned to twice-weekly surveillance were delivered 4 days earlier (264 vs 268 days; P =.04) and were more likely to have labor induced (n = 70, 82%, vs n = 54, 66%; P =.02) than those randomly assigned to fortnightly surveillance. Fifty-four babies (23%) were admitted to the neonatal nursery, but there were no differences in neonatal morbidity between the groups. CONCLUSION Maternal intervention (induction) was more common in the twice-weekly group. No differences in neonatal outcomes were detected. A much larger trial is required to determine the safety and potential benefits of less frequent surveillance of small-for-gestational-age fetuses with normal results of umbilical artery Doppler velocimetry studies.

Database: Medline

**Author(s):** Grobman, W A; Parilla, B V

**Source:** American journal of obstetrics and gynecology; Nov 1999; vol. 181 (no. 5); p. 1139-1141

**Publication Date:** Nov 1999

**Publication Type(s):** Journal Article

**PubMedID:** 10561633

**Abstract:**
OBJECTIVE Our purpose was to determine the positive predictive value of ultrasonographic surveillance for growth abnormalities in twin gestations as a function of gestational age.

STUDY DESIGN Women with twin gestations and delivery between January 1992 and March 1998 who had a 20- to 24-week sonogram with normal fetal anatomic findings and who had at least 1 sonogram showing abnormal growth were identified. Abnormal growth on ultrasonography was defined as an estimated fetal weight <10th percentile, abdominal circumference 20% difference in twin weights as a function of the heavier twin). Birth weights were then assessed for evidence of twin discordance or growth restriction.

RESULTS The positive predictive value for the occurrence of a growth abnormality at birth, after an abnormal growth finding on ultrasonography at any time during gestation, was 47.7%. The positive predictive value was greatest (85%) when suspected growth restriction was first documented at 20 to 24 weeks of gestation and decreased with increasing gestational age. Even though sonograms were obtained at a mean interval of 4.4 +/- 2.0 weeks, those gestations with normal growth at 20 to 24 weeks had an elapsed time of 10.3 +/- 3.9 weeks until a growth abnormality was subsequently detected.

CONCLUSION In twin gestations the positive predictive value of a sonogram for a growth abnormality at birth is significantly decreased after normal findings on a 20- to 24-week sonogram. This finding suggests that a routine 2- to 4-week interval between sonograms for all twin gestations may be unwarranted.

**Database:** Medline
30. Screening for fetal growth restriction: A mathematical model of the effect of time interval and ultrasound error

Author(s): Mongelli M.; Ek S.; Tambyrajia R.

Source: Obstetrics and Gynecology; Dec 1998; vol. 92 (no. 6); p. 908-912

Publication Date: Dec 1998

Publication Type(s): Article

PubMedID: 9840547

Available at Obstetrics & Gynecology - from Ovid (LWW Total Access Collection 2015 - Q1 with Neurology)

Abstract: Objective: We estimated the effect of ultrasound error and time interval between examinations on the false-positive rate for detecting fetal growth restriction (FGR). Methods: Using published growth curves for the fetal abdominal circumference and a coefficient of variation for ultrasound error of 5%, computer simulation was used to estimate false-positive rates in relation to the time interval between ultrasound examinations. Growth restriction was diagnosed when there was no apparent growth in fetal abdominal circumference between two consecutive examinations. In separate studies, the false-positive rate was plotted against gestational age at the first ultrasound examination. Results: There was a dramatic increase in false-positive rates as the time interval between examinations was reduced. When the initial scan was performed at 32 weeks, the false-positive rate increased from 3.2% for an interval of 4 weeks to 30.8% for an interval of 1 week. At a 2-week interval, the error was 16.9%. There was a significant increase in the false-positive rate as the gestational age at the initial ultrasound was increased. At 28 weeks, the false-positive rate with a 2-week interval was 11.8%, increasing to 24.1% at 38 weeks. By varying the coefficient of variation of the ultrasound error, the false-positive rate increased from 0.8% at an error of 2% to 31.9% at an error of 10%. Conclusion: Ultrasound scanning at 2-week intervals is associated with false-positive rates for growth restriction in excess of 10%, increasing to much higher rates late in the third trimester. Improved screening performance should be attainable by increasing the interval between scans and reducing measurement errors.

Database: EMBASE
31. Serial antenatal monitoring compared with labor induction in post-term pregnancies.

Author(s): Almström, H; Granström, L; Ekman, G

Source: Acta obstetricia et gynecologica Scandinavica; Sep 1995; vol. 74 (no. 8); p. 599-603

Publication Date: Sep 1995

Publication Type(s): Research Support, Non-u.s. Gov't Comparative Study Clinical Trial Journal Article

PubMedID: 7660763

Abstract: OBJECTIVE In view of the increased risk of obstetric and perinatal complications in post-term pregnancy, and the lack of consensus regarding clinical routines for fetal surveillance and labor induction, the aim of this prospective controlled study was to compare obstetric and perinatal outcome after serial monitoring until 43 weeks of gestation with that after labor induction at 42 gestational weeks.

MATERIALS AND METHODS A study group of 193 gravidae scheduled for serial monitoring until 43 weeks of gestation was compared with a control group of 205 gravidae admitted for induction of labor at 42 weeks. A third, high-risk, group comprised gravidae (from either of the foregoing groups) who had to be admitted for emergency induction of labor owing to increased fetal risk (i.e., the presence of oligohydramnios or a small-for-gestational-age fetus).

RESULTS The frequency of labor induction was significantly lower in the study group than among controls (p < 0.001), but the two groups did not differ in obstetric or perinatal outcome. As compared with these two low-risk groups, the high-risk group was characterized by significantly higher frequencies of instrumental delivery (p < 0.01), operative delivery for fetal distress (p < 0.001) and infants requiring neonatal intensive care (p < 0.001).

CONCLUSION As the wait-and-see policy with serial monitoring resulted in a lower rate of labor induction, but not in a lower rate of instrumental delivery or perinatal complication, medically the two routines would appear to be comparable. However, an individual approach with intensified fetal surveillance is to be recommended, as it is vital to identify post-term pregnancies where the fetus is at increased risk. The use of such new techniques as umbilical artery flow velocimetry would no doubt improve the management of high-risk post-term pregnancies.

Database: Medline
32. Sonographic evaluation of fetal growth: growth rate variability as a function of the interval between examinations.

Author(s): Halpern, E J; Nazarian, L N; Needleman, L; Hauck, W W; Kurtz, A B

Source: AJR. American journal of roentgenology; Dec 1994; vol. 163 (no. 6); p. 1491-1494

Publication Date: Dec 1994

Publication Type(s): Journal Article Research Support, U.s. Gov't, P.h.s.

PubMedID: 7992753

Abstract:

OBJECTIVE: Fetal growth rates determined on the basis of findings at two separate sonographic examinations can be used to detect growth abnormalities. This article determines the relationship between the length of the interval between examinations and the associated variability in measured fetal growth rates.

MATERIALS AND METHODS: We analyzed 1479 fetal measurements of the biparietal diameter, average abdominal diameter, and femur length from 539 normal pregnancies. Mean growth rates were computed as functions of gestational age. The standard deviation of the growth rate was computed as a function of the interval between examinations.

RESULTS: The standard deviation of fetal growth rates is relatively constant when the interval between examinations is 8-10 weeks or more, but increases substantially when the interval is fewer than 6 weeks.

CONCLUSION: From a purely statistical point of view, the optimal interval for assessment of fetal growth rates is 8-10 weeks or more. Shorter intervals, however, usually are mandated by the clinical situation. Correction factors can be used to determine the standard deviations and associated confidence intervals for fetal growth measured over a period of fewer than 10 weeks.

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