Intrauterine Growth Restriction. Guideline of the German Society of Gynecology and Obstetrics (S2k-Level, AWMF Registry No. 015/080, October 2016)

Intrauterine Wachstumsrestriktion. Leitlinie der DGGG (S2k-Level, AWMF-Registernummer 015/080, Oktober 2016)

Authors
Sven Kehl1, Jörg Dötsch2, Kurt Hecher3, Dietmar Schlembach4, Dagmar Schmitz5, Holger Stepan6, Ulrich Gembruch7

Affiliations
1 Frauenklinik, Universitätsklinikum Erlangen, Erlangen, Germany
2 Klinik und Poliklinik für Kinder- und Jugendmedizin, Universitätsklinikum Köln, Köln, Germany
3 Klinik für Geburtshilfe und Pränatalmedizin, Universitätsklinikum Hamburg-Eppendorf, Hamburg, Germany
4 Klinik für Geburtsmedizin, Vivantes Klinikum Neukölln, Berlin, Germany
5 Institut für Geschichte, Theorie und Ethik der Medizin, Uniklinik RWTH Aachen, Aachen, Germany
6 Abteilung für Geburtsmedizin, Universitätsklinikum Leipzig, Leipzig, Germany
7 Abteilung für Geburtshilfe und Pränatale Medizin, Universitätsklinikum Bonn, Bonn, Germany

Key words
IUGR, growth restriction, guideline

ZUSAMMENFASSUNG
Ziel Das Ziel dieser offiziellen Leitlinie, die von der Deutschen Gesellschaft für Gynäkologie und Geburtshilfe (DGGG) publi- ziert und koordiniert wurde, ist es, durch die Evaluation der relevanten Literatur einen konsensbasierten Überblick über die Diagnostik und das Management der intrauterinen Wachs- tumsrestriktion zu geben.

Methods Diese S2k-Leitlinie wurde durch einen strukturier- ten Konsens von repräsentativen Mitgliedern verschiedener Professionen im Auftrag der Leitlinienkommission der DGGG entwickelt.

Empfehlungen Es werden Empfehlungen zur Diagnostik, Management, Beratung, Prophylaxe und Screening gegeben.

ABSTRACT
Aims The aim of this official guideline published and coordinated by the German Society of Gynecology and Obstetrics (DGGG) was to provide consensus-based recommendations obtained by evaluating the relevant literature for the diagnostic treatment and management of women with fetal growth restriction.

Methods This S2k guideline represents the structured consensus of a representative panel of experts with a range of different professional backgrounds commissioned by the Guideline Committee of the DGGG.

Recommendations Recommendations for diagnostic treatment, management, counselling, prophylaxis and screening are presented.
I Guideline Information

Guidelines Program of the DGGG, OEGGG and SGGG

Information on the program is provided at the end of the article.

CITATION FORMAT

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Guideline documents

The complete long version (in German), a PDF slideshow for PowerPoint presentations and a summary of the conflicts of interest of all the authors is available on the AWMF homepage under: http://www.awmf.org/leitlinien/detail/ll/015-080.html

Guideline authors

The following professional and scientific societies/working groups/organizations/associations have stated their interest in contributing to the compilation of the guideline text and participating in the consensus conference and have sent representatives to the consensus conference (Table 1).

II Guideline Application

Purpose and Objectives

This guideline aims to summarize the current state of knowledge on intrauterine growth restriction (IUGR). It focuses on the definition, etiology, diagnosis and management of care and states the best time to deliver the baby.

Targeted areas of patient care

- Inpatient care
- Outpatient care

Target patient groups

This guideline is aimed at pregnant patients.

Target user groups/target audience

This guideline is aimed at the following groups:
- Gynecologists in private practice (non-hospital based)
- Hospital-based gynecologists
- Midwives

Adoption of the guideline and period of validity

This guideline is valid from May 1, 2017 through to April 30, 2020. Because of the contents of this guideline, the above-mentioned period of validity is only an estimate. If important changes to the available evidence should occur, then amendments to the guideline will be published even before the period of validity has expired, after a careful review of the new evidence in accordance with the methodology published by the AWMF.

Table 1 Authors and representatives: participation of the target user group.

| Author | Mandate holder | DGGG working group/AMWF/non AWMF professional association/organization/society |
|--------|----------------|---------------------------------------------------------------------------|
| Lead author and/or coordinating author: | | |
| PD Dr. med. Sven Kehl | German Society of Gynecology and Obstetrics (Deutsche Gesellschaft für Gynäkologie und Geburtshilfe e.V. [DGGG]) |
| PD Dr. med. Dagmar Schmitz | German Academy for Ethics in Medicine (Akademie für Ethik in der Medizin [AEM]) |
| PD Dr. med. Dietmar Schlembach | Working Group Hypertension in Pregnancy/Gestosis (Arbeitsgemeinschaft Schwangerschaftshochdruck/Gestose e.V. [AG Gestose]) |
| Prof. Dr. med. Kurt Hecher | Germany Society for Ultrasound in Medicine (Deutsche Gesellschaft für Ultraschall in der Medizin e.V. [DEGUM]) |
| Prof. Dr. med. Holger Stepan | German Society of Gynecology and Obstetrics (Deutsche Gesellschaft für Gynäkologie und Geburtshilfe e.V. [DGGG]) |
| Prof. Dr. med. Jörg Dötsch | German Society for Pediatric and Adolescent Medicine (Deutsche Gesellschaft für Kinder- und Jugendmedizin e.V. [DGKJ]) and German Society for Neonatology and Pediatric Intensive Care (Gesellschaft für Neonatologie und Pädiatrische Intensivmedizin [GNPI]) |
| Prof. Dr. med. Ulrich Gembruch | German Society of Perinatal Medicine (Deutsche Gesellschaft für Perinatale Medizin e.V. [DGPM]) |

Abbreviations

AED absent end-diastolic
AEDF absent end-diastolic flow
ARED absent or reversed end-diastolic
ASA acetylsalicylic acid
CPR cerebroplacental ratio
CTG cardiotocography
GW week of gestation
hCG human choriogonadotropin
IUFD intrauterine fetal death
IUGR intrauterine growth restriction
NT nuchal translucency
PAPP-A pregnancy-associated plasma protein A
PI pulsatility index
PIGF placental growth factor
PP13 placental protein 13
RDS respiratory distress syndrome
RED reversed end-diastolic
REDF reversed end-diastolic flow
RR relative risk
SGA small for gestational age
SDP single deepest pocket
s/p status post
STV short-term variation
III Methodology

Basic principles
The methodology used to prepare this guideline is determined by the class assigned to the guideline. The AWMF Guidance Manual (version 1.0) has set out the respective rules and requirements for different classes of guidelines. Guidelines are differentiated into lowest (S1), intermediate (S2) and highest (S3) class. The lowest class is defined as a set of recommendations for action compiled by a non-representative group of experts. In 2004 the S2 class was divided into two subclasses: the systematic evidence-based subclass S2e and the structural consensus-based subclass S2k. The highest S3 class combines both approaches.

This guideline is classified as: S2k

Grading of recommendations
While the classification of the quality of the evidence (strength of evidence) serves as an indication of the robustness of the published data and therefore expresses the extent of certainty/uncertainty about the data, the classification of the level of recommendation reflects the results of weighing up the desirable and adverse consequences of alternative approaches.

The grading of evidence and the grading of recommendations was not envisaged for S2k class guidelines. Individual recommendations are differentiated by syntax, not by symbols. The syntax chosen for the level of recommendation should be described in the background text (Table 2).

Expert statements included in this guideline which are not recommendations for action but are simple statements of fact are referred to as Statements. It is not possible to provide a level of evidence for these statements.

Achieving consensus and level of consensus
During structured consensus-based decision-making (S2k/S3 level), authorized participants present at a session vote on draft Statements and Recommendations. Discussions during sessions may lead to significant changes in the wording of Statements and Recommendations. The extent of agreement, which depends on the number of participants, is determined at the end of the session (Table 3).

Table 3 Classification of extent of agreement in consensus decision-making

| Symbol | Level of consensus | Extent of agreement in percent |
|--------|-------------------|-------------------------------|
| +++    | Strong consensus  | > 95% of participants agree   |
| ++     | Consensus         | 75–95% of participants agree  |
| +      | Majority agreement| 50–75% of participants agree  |
| –      | No consensus      | < 50% of participants agree   |

Expert consensus
As the name implies, this refers to consensus decisions taken with regard to specific Recommendations/Statements without a previous systematic search of the literature (S2k) or when evidence is lacking (S2e/S3). The term “Expert Consensus” (EC) used here is synonymous with terms such as “Good Clinical Practice” (GCP) and “Clinical Consensus Point” (CCP) used in other guidelines. The level of recommendation is graded as previously described in the Chapter Grading of recommendations but only semantically (“must”/“must not” or “should”/“should not” or “may”/“may not”) and without the use of symbols.
IV Guideline

1 Definition

| Consensus-based Statement 1.51 |
|-------------------------------|
| **Expert consensus** | **Level of consensus +++** |
| SGA = estimated fetal weight or birth weight < 10th percentile |
| IUGR = estimated fetal weight < 10th percentile and/or non-percentile appropriate fetal growth during pregnancy and pathological Doppler of umbilical artery or pathological Doppler of uterine artery or oligohydramnios |

References: [1 – 3]

| Consensus-based Statement 1.52 |
|-------------------------------|
| **Expert consensus** | **Level of consensus +++** |
| Estimated fetal weight or birth weight < 3rd percentile is associated with higher levels of morbidity and mortality. |

References: [4]

2 Epidemiology and Etiology

| Consensus-based Recommendation 2.E1 |
|-------------------------------------|
| **Expert consensus** | **Level of consensus +++** |
| Based on their full medical history, all pregnant women must be evaluated for potential risk factors which could predispose to IUGR. Further diagnostic investigations must be offered or carried out if risk factors are present. |

References: [5 – 7]

IUGR is a condition which affects approximately 5–10% of all pregnancies [5,6]. The etiology of IUGR is roughly divided into maternal, placental and fetal causes (▶ Table 4) [7]. Although the underlying pathophysiological mechanisms may be very different, they often (but not always) lead to the same endpoint: suboptimal uteroplacental perfusion and fetal nutrition. IUGR is therefore associated with high levels of morbidity and mortality.

▶ Table 4 Risk factors for developing intrauterine growth restriction. Common risk factors are highlighted in bold.

| Maternal causes | Alcohol abuse [8] |
|----------------|--------------------|
| Hypertensive disease of pregnancy (pre-eclampsia, gestational hypertension) [9] |
| Drug/nicotine abuse [10, 11] |
| Embryotoxic or fetotoxic medication [12] |
| **Maternal age (≥ 35/> 40 years)** [13] |
| Maternal weight (high or very low BMI) [14] |
| Low socio-economic status [15, 16] |
| Nulliparity [17] |
| s/p hypertensive disorder in a previous pregnancy |
| s/p IUD [9] |
| s/p SGA/IUGR [9] |
| Preexisting maternal diseases, which can lead to reduced uteroplacental perfusion or reduced oxygenation of maternal blood, e.g.: |
| Chronic respiratory disease |
| Chronic hypertension [18] |
| Chronic renal disease [19] |
| Diabetes mellitus with vascular disease [20] |
| Heart disease, especially cyanotic heart disease [21] |
| Severe anemia |
| Systemic lupus erythematosus and antiphospholipid syndrome [22] |

| Uteroplacental causes | Placental abruption [23] |
|----------------------|-------------------------|
| Velamentous cord insertion |
| Placental infarction [24] |
| Disorders of placentation with inadequate trophoblast invasion and increased maternal risk of pre-eclampsia [25] |
| Placental tumors |

| Fetal causes | Chromosomal abnormalities and syndromic disease [26, 27] |
|--------------|--------------------------------------------------------|
| Intrauterine infections (particularly cytomegaly, toxoplasmosis, rubella, varicella zoster virus) |
| Multiple pregnancy [28] |
Diagnostics to Detect Possible IUGR

In addition to taking the patient’s history, a clinical examination and various diagnostic procedures must be carried out to rule out or confirm IUGR. This is an important part of antenatal care as the majority of IUGR are not detected prenatally [29] and undetected IUGR is associated with an 8-fold higher risk of intrauterine fetal death [30].

3.1 Clinical examination

3.2 Sonography

3.2.1 Biometry in early pregnancy (crown-rump length)

3.2.2 Fetometry

In addition to estimated fetal weight, fetal abdominal circumference is the most important indicator of IUGR. Fetal head-to-abdomen discrepancy can also be an indication of IUGR. Assessment of estimated fetal weight should also take maternal and paternal characteristics into account [37–40]. If the estimated fetal weight is below the 10th percentile, further diagnostic investigations must be carried out (including precise sonographic diagnostics, Doppler sonography).

3.2.3 Amniotic fluid

3.2.4 Precise sonographic diagnostics (additional procedures for the differential diagnosis of different organs)

3.3 Doppler sonography

3.4 Cardiotocography (CTG)

Cardiotocography (CTG) is known to have a high false-positive rate for the prediction of poor outcomes and is more likely to detect acute hypoxic events than chronic conditions [49]. Its value for detecting possible IUGR is therefore only limited; nevertheless, according to the German Maternity Guidelines, CTG should be carried out as part of antenatal care if there is a suspicion of placental insufficiency [48].

4 Differential diagnosis of a SGA/IUGR fetus

4.1 Chromosomal anomalies

4.2 Infections

5 Management of IUGR

There is still very little evidence about the best antenatal method to monitor a fetus with IUGR [54]. No single monitoring method provides a valid prediction for the outcome of IUGR, which is why a combination of different procedures to monitor growth-retarded fetuses is recommended.
5.1 Diagnostic monitoring

5.1.1 Clinical examination

**Consensus-based Recommendation 5.E10**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

Monitoring should be carried out to detect early signs of pre-eclampsia when IUGR is caused by uteroplacental insufficiency.

References: [4, 61]

**Consensus-based Statement 5.S3**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

Normal results for Doppler sonography of the umbilical artery in early IUGR is associated with a low risk of poor perinatal outcome.

References: [4, 61]

**Consensus-based Statement 5.S4**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

Diastolic zero flow (AED flow) and reverse diastolic blood flow (RED flow) particularly in the umbilical artery are commonly associated with poor perinatal outcome when IUGR is present.

References: [62 – 67]

**Consensus-based Recommendation 5.E11**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

Serial sonographic monitoring of fetal growth must be carried out when IUGR has been identified or there is a suspicion of IUGR.

References: [55]

**Consensus-based Recommendation 5.E12**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

The interval between individual sonography scans to monitor fetal growth should be at least two weeks.

**Consensus-based Recommendation 5.E13**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

The SDP (single deepest pocket) method should be used to assess amniotic fluid volume.

References: [56 – 58]

**Consensus-based Recommendation 5.E14**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

Sonographic assessment of amniotic fluid volume must only be interpreted in the context of and together with other monitoring methods.

References: [56 – 58]

**Consensus-based Recommendation 5.E15**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

If Doppler sonography of the umbilical artery shows abnormalities, additional Doppler scans of other vessels (middle cerebral artery, ductus venosus) should be carried out.

References: [59, 60]

**Consensus-based Recommendation 5.E16**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

The intervals between control Doppler scans should always depend on the severity of IUGR and on previous Doppler findings.

**Consensus-based Recommendation 5.E17**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

It is not clear how long the intervals between control Doppler scans should be if the findings of the umbilical artery are pathological. If pulsatility is increased (PI > 95th percentile) controls should be carried out at least once a week; in cases of ARED flow, monitoring must be carried out at even more frequent intervals.

**Consensus-based Recommendation 5.E18**

| Expert consensus | Level of consensus *** |
|------------------|------------------------|

When Doppler results for the umbilical artery are normal, repeat control scans every two weeks appear to be sufficient to monitor early IUGR. More frequent control scans may be needed in cases of severe IUGR.

References: [68, 69]
5.1.5 Doppler sonography (middle cerebral artery)

**Consensus-based Recommendation 5.E19**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Doppler sonography of the middle cerebral artery should be done in addition to sonography of the umbilical artery when IUGR is detected. |

References: [70 – 72]

5.1.6 Doppler sonography (cerebroplacental ratio, CPR)

**Consensus-based Statement 5.S6**

| Expert consensus | Level of consensus ++ |
|------------------|-----------------------|
| Pathological Doppler findings for the middle cerebral artery (PI < 5th percentile) in late IUGR at term increases the risk of cesarean section and poor perinatal outcome. |

References: [73 – 75]

5.1.7 Doppler sonography (ductus venosus)

**Consensus-based Statement 5.S8**

| Expert consensus | Level of consensus +++ |
|------------------|-----------------------|
| The ductus venosus is an indication of imminent or manifest acidemia and the risk of fetal death. |

References: [81 – 83]

5.1.8 Doppler sonography (other vessels)

**Consensus-based Recommendation 5.E20**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Monitoring of early IUGR must include Doppler sonography of the ductus venosus. |

References: [72, 84, 85]

5.1.9 Cardiotocography (CTG)

**Consensus-based Recommendation 5.E21**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Cardiotocography (CTG) must not be the only procedure used to monitor IUGR. |

References: [86, 87]

5.1.10 Computerized CTG (Dawes-Redman CTG analysis)

**Consensus-based Statement 5.S9**

| Expert consensus | Level of consensus +++ |
|------------------|-----------------------|
| Analysis of short-term fetal heart variation based on computerized CTG (Dawes-Redman CTG analysis) may be useful for monitoring IUGR. |

References: [84, 88 – 100]

5.1.11 Biophysical profile

**Consensus-based Recommendation 5.E22**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| The biophysical profile (scoring) should not be used to monitor IUGR. |

References: [84, 101 – 103]

5.2 Antenatal corticosteroids (RDS prophylaxis)

**Consensus-based Recommendation 5.E23**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Antenatal corticosteroids should be administered once between GW 24 + 0 and GW 34 + 0 if it is expected that the infant will be delivered within the next 7 days. |

References: [104]

5.3 Magnesium sulfate for fetal neuroprotection

**Consensus-based Recommendation 5.E24**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Magnesium sulfate for fetal neuroprotection may be administered if preterm birth (GW < 32 + 0) is expected, as there are indications that it has a neuroprotective effect. |

References: [105 – 115]
5.4 Delivery

5.4.1 Place of delivery

**Consensus-based Recommendation 5.E25**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| If IUGR is present, the infant must be delivered in a perinatal center with a neonatal intensive care unit and an experienced team on hand to provide immediate and continuous care. | |

References: [116, 117]

5.4.2 Time of delivery

**Consensus-based Recommendation 5.E26**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Early IUGR and late IUGR must be assessed differently. Increasing deterioration in a fetus with early IUGR is reflected in abnormalities of venous Doppler parameters, while increasing deterioration in a fetus with late IUGR is primarily visible in abnormal cerebral Doppler findings. | |

References: [62]

**Consensus-based Statement 5.S10**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Age of gestation is a significant factor affecting survival without morbidity. | |

References: [3, 72, 119, 120]

**Consensus-based Recommendation 5.E28**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| If CTG pathologies such as recurrent decelerations resistant to treatment occur, delivery of the infant must be considered at all times. | |

References: [100]

**Consensus-based Recommendation 5.E29**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Delivery of the infant must be considered if short-term variation (STV) < 2.6 ms occurs between GW 26 + 0 and GW 28 + 6 or a STV < 3 ms occurs between GW 29 + 0 and GW 32 + 0. | |

References: [100]
5.4.3 Type of delivery

Consensus-based Recommendation 5.E37

Expert consensus | Level of consensus +++
--- | ---
In the case of an isolated SGA (normal Doppler results, no additional risks), delivery may be considered from GW 38 + 0.

References: [124 – 126]

Consensus-based Recommendation 5.E38

Expert consensus | Level of consensus +++
--- | ---
Outpatient or inpatient monitoring and care

Bed rest
There is very little evidence-based data on hospitalization with bed rest when there is a suspicion of fetal growth restriction, and the data have not shown any benefit [134].

Diet
Changes in diet, dietary measures or additional intake of food supplements (e.g. calcium [135]) have not shown any benefit [136] and are therefore not recommended.

Consensus-based Recommendation 5.E39

Expert consensus | Level of consensus +++
--- | ---
In the case of an isolated SGA (normal Doppler results, no additional risks), the due date must not be exceeded.

Consensus-based Recommendation 5.E40

Expert consensus | Level of consensus +++
--- | ---
In the case of IUGR with normal Doppler results or increased pulsatility in the umbilical artery (> 95th percentile), labor may be induced with the goal of vaginal delivery but not if ARED flow is present. However the higher risk of complications must be taken into account and continuous intrapartum monitoring is required.

References: [127 – 133]

5.4.4 Additional recommendations

Outpatient or inpatient monitoring and care

Consensus-based Recommendation 5.E41

Expert consensus | Level of consensus +++
--- | ---
The decision for either outpatient or inpatient monitoring and care of the pregnant woman with IUGR must be taken on an individual basis.

Cessation of nicotine use

Consensus-based Recommendation 5.E42

Expert consensus | Level of consensus +++
--- | ---
Cessation of nicotine use must be recommended to all pregnant women.

References: [137]

Progesterone

Progesterone has shown no benefit in reducing IUGR [138] and should therefore not be administered for that purpose.

Maternal oxygen administration

The studies on the benefits of maternal oxygen administration are insufficient and some have methodological flaws. These studies were evaluated in an older Cochrane analysis which drew the conclusion that the existing evidence is insufficient to assess the benefits and risk of maternal oxygen administration [139]; maternal oxygen should therefore not be administered.

Other interventions

Numerous interventions which aim to improve blood flow to the placenta have been studied [140]. But neither the increase in plasma volume [141] nor the administration of low-dose ASA [142] or sildenafil [143, 144] showed any benefit, and they are therefore not recommended.

Antihypertensive therapy of pregnant women with hypertensive disease does not improve fetal growth [145, 146] and should not be recommended and neither should the administration of NO donors or vasodilator substances as they have not been sufficiently investigated yet [147].

6 Information and counseling

The pregnant woman or parents-to-be should receive detailed information and extensive counseling sessions about IUGR as a complication of pregnancy and the individual course and consequences of IUGR. The mother/parents-to-be should also be told that the infant could be constitutionally small, which does not inevitably lead to increased perinatal morbidity. These talks should be given by an interdisciplinary team which includes a specialist for prenatal medicine/obstetrician and neonatologist. Depending on the fetal clinical picture, additional pediatric specialists or specialists for human genetics should also be consulted. In addition to information about the possible causes, information should also be provided about the short-term and long-term consequences, the risk of recurrence and, depending on the case, the possible diagnostic investigations.

The individual medical, psychological and social questions of the pregnant woman or the parents-to-be about the diagnosis must then be discussed during a comprehensive medical consultation. All necessary decisions should be taken as part of a joint decision-making process. The most important results of the information and counseling sessions should be documented transparently (see also the S2k-guideline “Preterm infants born at the limits of viability”, currently only available in German: “Frühgeborene an der Grenze der Lebensfähigkeit” (196)).
Additional psychological or pastoral care, ideally initiated before the birth, can be an important aspect for parents-to-be [148].

7 Prophylaxis
Particularly after a previous IUGR pregnancy, the aim must be to prevent a recurrence of IUGR. Numerous approaches have been used in the past, but only a few of them offer an evidence-based benefit.

Acetylsalicylic acid (ASA)

**Consensus-based Recommendation 7.E43**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| If there is a risk of uteroplacental malperfusion and a risk of IUGR, prophylactic intake of low-dose ASA should be started at ≤ 16 GW. |                    |

References: [149–151]

Antihypertensive therapy
Antihypertensive therapy of mild to moderate hypertension during pregnancy does not appear to increase the risk of SGA fetus (RR: 1.02; 95% CI: 0.89–1.16) [145]. However, the use of beta-blockers in antihypertensive therapy is associated with growth restriction (RR: 1.36, 95% CI: 1.02–1.82) [152] and should therefore be avoided if possible.

Bed rest
There is no evidence that prophylactic (outpatient or inpatient) bed rest can prevent IUGR [134].

Diet

**Consensus-based Recommendation 7.E44**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Special forms of nutrition or food supplements have not been shown to offer an evidence-based benefit and should therefore not be recommended as prophylaxis against IUGR. |                    |

References: [135, 153 – 158]

Heparin

**Consensus-based Statement 7.S11**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| The administration of low-molecular-weight heparin appears to be a promising prophylactic approach in IUGR. Nevertheless, the currently available evidence is not sufficient for it to be recommended, particularly as there is insufficient evidence concerning possible severe side-effects. |                    |

References: [159 – 161]

8 Screening
Antenatal detection of IUGR is vitally important, as early detection significantly influences both the course of pregnancy and the neonatal outcome [29, 164, 165].

Medical history
A careful investigation of the patient’s medical history, particularly with regard to potential risk factors for IUGR (see Chapter 2. Epidemiology and Etiology), is essential as close monitoring can be initiated if there is an increased risk of IUGR [166].

Clinical examination
(Cf. Chapter 3.1. Clinical examination)

Sonography
The basic prerequisite for effective screening is accurate data collection (Chapter 3.2.1. Crown-rump length).

In addition, it is suggested that, similar to pre-eclampsia screening in the 1st trimester of pregnancy, an attempt could be made to screen for SGA/IUGR using a combination of different markers (maternal medical history, Doppler sonography of the uterine arteries, middle arterial pressure, NT and the maternal serum markers PAPP-A, free β-hCG, PI GF, PI P13, and ADAM 12). General screening is not currently recommended yet.

Doppler sonography

**Consensus-based recommendation 8.E46**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| Abnormal Doppler results for the uterine arteries in the form of increased pulsatility (PI > 95th percentile) should be a signal to start regular sonographic monitoring of fetal growth and Doppler sonography of the umbilical artery. |                    |

References: [167, 168]

Nicotine

**Consensus-based Recommendation 7.E45**

| Expert consensus | Level of consensus +++ |
|------------------|------------------------|
| All pregnant women who smoke must be informed that abstaining from nicotine can reduce the risk of IUGR. |                    |

References: [162, 163]
9 Appendix
(Figs. 1 and 2)

Suspected diagnosis of IUGR

- Determine age of gestation (4.2.1.)
- Sonographic estimation of fetal weight (4.2.2.)
- Review fetal weight development to date

Estimated fetal weight < 10th percentile
AND/OR
non-percentile appropriate fetal growth during pregnancy

- Doppler sonography (4.3.)
- Assessment of amniotic fluid volume (4.2.3.)
- Sonography for differential diagnosis (4.2.4.)
- Exclusion of chromosomal anomalies (5.1.)
- Examination for possible infections (5.2.)

Diagnosis of IUGR

- Estimated fetal weight < 10th percentile AND/OR
- non-percentile appropriate fetal growth during pregnancy AND
- pathological Doppler sonography of the umbilical artery OR
- pathological Doppler sonography of the uterine arteries OR
- oligohydramnios

- Diagnosis of SGA
  - Estimated fetal weight < 10th percentile

- Structural abnormality
  - AND/OR
  - abnormal karyotype
  - AND/OR
  - infection

Diagnosis of IUGR

- Doppler sonography (6.1.4. – 6.1.8.)
  - CTG (6.1.9.)/Dawes-Redman CTG analysis (6.1.10.)

  - Doppler sonography of the umbilical artery
    - Normal
    - Control scan every 2 weeks
    - till GW 38–39

  - Doppler sonography of the umbilical artery
    - PI > 95th percentile
    - Control scan at least every week
    - till GW 37+0

  - Doppler sonography of the umbilical artery
    - AEDF
    - Control scan daily or every few days
    - till GW 34+0

  - Doppler sonography of the umbilical artery
    - REDF
    - Control scan daily or every few days
    - till GW 32+0

  - Delivery
    - In a perinatal center with a neonatal intensive care unit (6.4.1.)
    - Possibly administration of antenatal corticosteroids (6.2.)
    - Possibly administration of magnesium sulfate (6.3.)

- Doppler sonography of the middle cerebral artery
  - PI < 5th percentile from GW 37+0

- Doppler sonography of the ductus venosus
  - PI > 95th percentile
  - absent a-wave/reverse flow a-wave

- CTG and/or Dawes-Redman CTG analysis pathological

Fig. 1 Algorithm for the diagnosis of IUGR.

Fig. 2 Algorithm for the management of IUGR.
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German Society of Gynecology and Obstetrics
(Deutsche Gesellschaft für Gynäkologie und Geburtshilfe e. V. [DGGG])
Head Office of DGGG and Professional Societies
Hausvogteiplatz 12
DE-10117 Berlin
info@dggg.de
http://www.dggg.de/

President of DGGG
Prof. Dr. Birgit Seelbach-Göbel
Universität Regensburg
Klinik für Geburtshilfe und Frauenheilkunde
St. Hedwig-Krankenhaus Barmherzige Brüder
Steinmetzstraße 1–3
DE-93049 Regensburg

DGGG Guidelines Representative
Prof. Dr. med. Matthias W. Beckmann
Universitätsklinikum Erlangen
Frauenklinik
Universitätsstraße 21–23
DE-91054 Erlangen

Guidelines Coordination
Dr. med. Paul Gaß, Tobias Brodkorb, Marion Gebhardt
Universitätsklinikum Erlangen
Frauenklinik
Universitätsstraße 21–23
DE-91054 Erlangen
fk-dggg-leitlinien@uk-erlangen.de
http://www.dggg.de/leitlinienstellungnahmen

OEGGG

Austrian Society of Gynecology and Obstetrics
(Österreichische Gesellschaft für Gynäkologie und Geburtshilfe [OEGGG])
Innrain 66A
AT-6020 Innsbruck
stephanie.leutgeb@oeggg.at
http://www.oeggg.at

President of OEGGG
Prof. Dr. med. Petra Kohlberger
Universitätsklinik für Frauenheilkunde Wien
Währinger Gürtel 18–20
AT-1180 Wien

OEGGG Guidelines Representative
Prof. Dr. med. Karl Tamussino
Universitätsklinik für Frauenheilkunde und Geburtshilfe Graz
Auenbruggerplatz 14
AT-8036 Graz

gynécologie suisse

Swiss Society of Gynecology and Obstetrics
(Schweizerische Gesellschaft für Gynäkologie und Geburtshilfe [SGGG])
Gynécologie Suisse SGGG
Altenbergstraße 29
Postfach 6
CH-3000 Bern 8
sekretariat@sggg.ch
http://www.sggg.ch/

President of SGGG
Dr. med. David Ehm
FMH für Geburtshilfe und Gynäkologie
Nägeligasse 13
CH-3011 Bern

SGGG Guidelines Representative
Prof. Dr. med. Daniel Surbek
Universitätsklinik für Frauenheilkunde Geburtshilfe und feto-maternale Medizin
Inselspital Bern
Effingerstraße 102
CH-3010 Bern