Abstract

Purpose: Official guideline published and coordinated by the German Society of Gynecology and Obstetrics (DGGG). Hypertensive pregnancy disorders contribute significantly to perinatal as well as maternal morbidity and mortality worldwide. Also in Germany these diseases are a major course for hospitalization during pregnancy, iatrogenic preterm birth and long-term cardiovascular morbidity.

Methods: This S1-guideline is the work of an interdisciplinary group of experts from a range of different professions who were commissioned by DGGG to carry out a systematic literature search of positioning injuries. Members of the participating scientific societies develop a consensus in an informal procedure. Afterwards the directorate of the scientific society approves the consensus.

Recommendations: This guideline summarizes the state-of-art for classification, risk stratification, diagnostic, treatment of hypertensive pregnancy disorders.

Zusammenfassung


Methoden: Mitglieder der beteiligten Fachgesellschaften entwickeln in einem informellen Prozess einen Konsensus. Anschließend bestätigen die Direktorien der Fachgesellschaften diesen Konsens.

Empfehlungen: In der Leitlinie wird der aktuelle Standard für die Benennung, Früherkennung, Diagnostik, Behandlung und Nachsorge hypertensiver Schwangerschaftserkrankungen gegeben.

Guideline Information

Guidelines Program of DGGG, OEGGG and SGGG
Information on this topic is provided at the end of the guideline.

Citation format

Guideline documents
The editorially complete, long version and a PDF slide set suitable for PowerPoint presentation of these guidelines as well as a summary of the conflicts of interest of all the authors can be found on the homepage of AWMF: http://www.awmf.org/leitlinien/detail/ll/015-018.html

Authors
See Table 1.
II Using this Guideline

Purpose and objectives
Hypertensive pregnancy disorders contribute significantly to perinatal as well as maternal morbidity and mortality worldwide. Also in Germany these diseases are a major course for hospitalization during pregnancy, iatrogenic preterm birth and long-term cardiovascular morbidity. The guideline summarizes the state-of-art for classification, risk stratification, diagnostic, treatment of hypertensive pregnancy disorders with the aim to reduce perinatal as well as maternal morbidity and mortality.

Patient care
Outpatient and inpatient care.

Target audience
This guideline is addressed to the following groups of people:
- Obstetricians
- Audience of patients:
- pregnant women

Period of validity
The validity of this guideline was confirmed by the boards/responsible persons of the participating professional associations/working groups/organizations/societies as well as by the board of the DGGG and the DGGG Guideline Commission in November 2013 and thereby approved in its entirety. This guideline is valid from December 01, 2013 to November 30, 2016. The period of validity has been estimated based on the guideline’s contents. The guideline can be updated earlier if necessary; likewise, the guideline’s period of validity can be extended if it continues to mirror the current state of knowledge.

III Guideline

1 Methodology
The methodology for the compilation of this guideline is prescribed by the classification assigned to the guideline. The AWMF Guidance Manual and Rules for Guideline Development (Version 1.0) sets out the rules for classifying guidelines. Guidelines are differentiated into lowest (S1), moderate (S2) and highest (S3) class. The lowest class of guideline is defined as consisting of a set of recommendations for action compiled by a representative group of experts from medical societies. In 2004 the S2 class is divided into two subclasses: S2e (evidence-based) and S2k (consensus-based). The highest class (S3) combines both approaches. This guideline is classified as: S1

The guideline, which was created in November 1999 and was already present in a previous version from 2008, was adapted according to the current literature and existing international guidelines. The contents of the guideline have been edited by the entire group of experts in three meetings in debated discussions. After editorial and content revision of the guidelines by the management of the expert group, agreement between the authors took place using written correspondence. A version was adopted which was accepted by all authors. The Guidelines Commission and Board of DGGG accepted the guideline in November 2013.

2 Introduction
Hypertensive disorders occur in 6–8% of all pregnancies, contribute to 20–25% of perinatal mortality and are the first and second most common causes of maternal death in Europe. Preeclampsia is of particular importance (10–15% of all maternal deaths are associated with preeclampsia/eclampsia) and is responsible for at least 70000 maternal deaths per year worldwide (for review: Lo et al. [1]). Even today, > 90% of maternal deaths from PE/E in Eu-

Table 1 Authors.

<table>
<thead>
<tr>
<th>Author Mandate holder</th>
<th>DGGG working group/professional association/organization/society</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinating lead author:</td>
<td>German Society of Gynecology and Obstetrics (Deutsche Gesellschaft für Gynäkologie und Geburtshilfe [DGGG])</td>
</tr>
<tr>
<td>Other lead guideline authors:</td>
<td>Pregnancy Hypertension/Gestosis Working Group of DGGG</td>
</tr>
<tr>
<td>Other members of the task force:</td>
<td>Arbeitsgemeinschaft Gestose-Frauen e. V.</td>
</tr>
<tr>
<td>Prof. Dr. med. Walter Klockenbusch</td>
<td>International Society for the Study of Hypertension in Pregnancy (ISSHP)</td>
</tr>
<tr>
<td>Prof. Dr. med. Werner Rath</td>
<td>International Society for the Study of Hypertension in Pregnancy (ISSHP)</td>
</tr>
<tr>
<td>Prof. Dr. med. Burkhard Schaaf</td>
<td>International Society for the Study of Hypertension in Pregnancy (ISSHP)</td>
</tr>
<tr>
<td>Prof. Dr. med. Thomas Walther</td>
<td>International Society for the Study of Hypertension in Pregnancy (ISSHP)</td>
</tr>
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</table>

Abbreviations

ACE Angiotensin Converting Enzyme
ASS acetylsalicyl acid
BMI Body-Mass-Index
CTG Cardiotocography
DIG disseminated intravascular coagulation
E eclampsia
EFCNI European Foundation for the Care of Newborn Infants
FPR false positive rate
HELLP Haemolysis Elevated Liver enzymes
Low Platelet count
K Korotkoff
LR Likelihood ratio
MoM multiple of the median
PAPP-A pregnancy- associated plasma protein A
PE preeclampsia
PlGF placental growth factor
PI pulsatility index
RI Resistance-Index
RR relative risk
SSW week of gestation
sFlt-1 soluble fms-like tyrosine kinase-1
rope are potentially avoidable [2,3]. In Europe, the incidence of preeclampsia is approximately 2% [1,4,5].

3 Classification of hypertensive disorders in pregnancy and postpartum

The following classification, as well as the definitions, takes into account the recommendations of the American and Australian Societies and the International Society for the Study of Hypertension in Pregnancy [6–11].

3.1 Gestational hypertension (Pregnancy-induced hypertension)

Definition: Blood pressure values ≥140/90 mmHg without proteinuria in a previously normotensive pregnant woman occurring after the completed 20th week of pregnancy.

Cave: Mild preeclampsia develops from gestational hypertension in up to 46% of cases and severe preeclampsia develops in 9.6% [12].

3.2 Preeclampsia (Synonym: Gestosis)

Definition: Gestational hypertension and proteinuria (≥ 300 mg/24 h detected in 24-h urine or > 30 mg/mmol protein-creatinine ratio in a random urine sample occurring after the 20th completed week of pregnancy.

Cave: Clinical signs of renal impairment, hepatic involvement, pulmonary, haematological/neurological disorders or fetal growth restriction indicate the development of preeclampsia. Based on the different pathophysiology and the different risk profile for mother and child, a distinction is made between early (early-onset manifestation < 34 weeks) and late (late-onset) pre-eclampsia [13,14].

Preeclampsia is referred to as severe preeclampsia if at least one of the following criteria is also satisfied [8,11,15]:
- Blood pressure ≥160/110 mmHg
- Renal impairment (creatinine ≥79.6 µmol/l [equates to 0.9 mg/dl] or oliguria < 500 ml/24 h)
- Liver involvement (transaminase increase, persistent upper abdominal pain)
- Lung oedema
- Haematological disorders (thrombocytopenia < 100 Gpt/l, haemolysis
- Neurological symptoms (severe headache, impaired vision
- Fetal growth retardation (estimated fetal weight < 5 percent and/or pathological umbilical artery Doppler)

The degree of proteinuria is no longer a criterion for the definition of serious preeclampsia [11,15].

3.3 Eclampsia

Definition: Tonic-clonic seizures occurring during preeclampsia which cannot be attributed to any other cause.

Cave: Only associated with severe hypertension in about 50% and possible even in the absence of hypertension or proteinuria (14–34% of cases) [16,17]. 21% of women have no clinical symptoms in the week before the onset of preeclampsia [18].

3.4 HELLP syndrome

Definition: Triad of:
(H): haemolysis
(EL): elevated liver enzymes
(LP): low platelets (< 100 Gpt/l)

Cave: There is no significant proteinuria in 5–15%, no hypertension in up to 20% of cases and hypertension and proteinuria can both be absent at the same time [19].

3.5 Chronic hypertension

Definition: Hypertension ≥140/90 mmHg diagnosed preconceptually or in the first half of pregnancy (before the 20th week of pregnancy) [20].

3.6 Superimposed preeclampsia

Definition: Chronic hypertension and newly emerged/worsening proteinuria after 20 weeks of pregnancy or appearance of clinical or laboratory features of severe preeclampsia (see above).

Cave: Superimposed preeclampsia develops from chronic hypertension in 17–25% (50% of these before the 34th week of pregnancy) [20].

4 Screening, prediction and prevention

A significant, single test for reliable early recognition of preeclampsia is not yet available [4,21–26]. Anamnestic details (pregnancy record), mean arterial blood pressure, biochemical markers and Doppler sonography can be used in the first or second trimester for risk assessment [27].

4.1 Screening in the first trimester

A risk assessment of maternal characteristics (age, medical history, body mass index, ethnicity), in conjunction with biophysical factors (after MoM adjusted pulsatility of the uterine artery, mean arterial blood pressure) and biochemical risk markers (e.g. pregnancy-associated plasma protein A [PAPP-A], placent growth factor [PIGF]) allows an individual risk calculation, in particular for early-onset preeclampsia.

With this combination of different methods, detection rates for early preeclampsia of 93.4 and 95.2% can be achieved with a false positive rate (FPR) of 5 or 10%. However, this algorithm has significantly poorer detection rates of 37.8 and 71.1% for late preeclampsia [5,28].

The predictive value of the different biophysical and biochemical methods as the sole screening test is low and their use for the prediction of preeclampsia is not recommended because of the high FPR [4,5,24,28–32]. However, the high negative predictive value (>97%) of the test method for early-onset preeclampsia or the development of intrauterine growth retardation should be emphasised [30,33,34]. Regional differences as well as socio-economic and ethnic factors can influence the results and their significance [35,36] therefore their uncritical acceptance in routine clinical practice is not recommended (especially without appropriate organizational structures and adequate counselling) [37].

4.2 Screening and prediction in the second trimester

The measurement of the mean pulsatility index (PI) – alone or in combination with postspysolic notch – is considered the best marker for the prediction of preeclampsia with a sensitivity of up to 93% [22,23,38–40], in a low-risk group the recognition rate of the mean pulsatility index > 1.6 (95th percentile) for early-onset preeclampsia at 5% FPR was 78% and 42.8% for preeclampsia overall [22]. The detection rates for late preeclampsia are significantly lower, depending on gestational age [22]. Of clinical relevance here is also the high specificity and negative predictive value of Doppler ultrasound parameters of up to 99% [38,39,41,42].

The presentation of postsystolic notch in the uterine artery is
a reliable sign when screening for preeclampsia; however the error rate is unfortunately high because of a certain subjectivity. A further risk estimation for the development of preeclampsia and prognostic assessment of the clinical course of the disease with a pathological uterine artery Doppler in the 2nd trimester can be achieved by determining angiogenesis/antiangiogenesis factors [22, 23, 25, 42–45]. It has been shown that the serum levels of sFlt-1 (soluble fragment of the VEGF receptor 1) and PI GF already alter weeks before manifestation of the disease and that the sFlt-1/PIGF ratio has a prognostic value [43, 46–50].

4.3 Prevention
Currently the only effective way of preventing preeclampsia in women with risk factors (e.g. a history of severe preeclampsia) is to begin oral administration of low-dose acetylsalicylic acid (ASA: 75–150 mg/day) during early pregnancy (before 16 weeks) [51]. This approach significantly reduces the risk of preeclampsia before the 37th week of pregnancy, but not near term [52], as well as the risk of (severe) preeclampsia, pregnancy-induced hypertension and IUGR with pathological uterine artery Doppler results [53].

In Germany, an aspirin dosage of 100 mg/day up to 34 + 0 weeks has been established. General aspirin prophylaxis is not indicated.

5 Antenatal screening
5.1 Risk factors for the development of preeclampsia
5.1.1 Clinical history risk factors (Table 2) [39, 54–62]

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Relative risk (RR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antiphospholipid syndrome</td>
<td>~ 9</td>
</tr>
<tr>
<td>History of preeclampsia</td>
<td>~ 7</td>
</tr>
<tr>
<td>Body Mass Index &gt; 30</td>
<td>~ 3–5</td>
</tr>
<tr>
<td>Pre-existing diabetes mellitus</td>
<td>~ 3.5</td>
</tr>
<tr>
<td>Family history</td>
<td>~ 3</td>
</tr>
<tr>
<td>Pre-existing kidney disease</td>
<td>~ 3</td>
</tr>
<tr>
<td>First pregnancy</td>
<td>~ 2.5–3</td>
</tr>
<tr>
<td>Age &gt; 40</td>
<td>~ 2</td>
</tr>
<tr>
<td>Chronic hypertension</td>
<td>1</td>
</tr>
<tr>
<td>† with 1 additional risk factor</td>
<td>1.55</td>
</tr>
<tr>
<td>† with 2 additional risk factors</td>
<td>3</td>
</tr>
<tr>
<td>BP diastolic &gt; 110 mmHg (&lt; 20 weeks)</td>
<td>3.2</td>
</tr>
<tr>
<td>Autoimmune diseases</td>
<td>7–9.7</td>
</tr>
<tr>
<td>Ethnicity (African-American)</td>
<td>2</td>
</tr>
</tbody>
</table>

5.1.2 Pregnancy-associated risk factors (Table 3) [39, 56, 59, 62]

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Relative risk (RR)</th>
<th>Likelihood ratio (LR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilateral notching/ increased PI/RI in the uterine artery persisting &gt; 24 SSW</td>
<td>3.4–6.5</td>
<td></td>
</tr>
<tr>
<td>Multiple pregnancy</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>IVF/egg cell donation</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Gestational diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrops fetalis, trisomies, molar pregnancy</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Cave: In cases of confirmed proteinuria, repeated measurements to estimate the prognosis and monitoring of preeclampsia are not useful [11, 78].

5.4 Oedema

Oedema alone is an uncharacteristic symptom that is only relevant if it increases rapidly, i.e. if significant weight gain is detected within a short period of time (≥ 1 kg/week in the III trimester) [86] or if there is pronounced facial oedema. If oedema/weight gain develops rapidly in conjunction with proteinuria, it can lead to eclampsia even without hypertension (cf. definition of preeclampsia).

6 Out-patient and clinical monitoring

6.1 Clinical chemistry and haematology

The following clinical chemistry/haematological parameters can be altered, depending on the disorder (Table 4) [6–11, 49, 87–91]:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Pathological standard value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haemoglobin</td>
<td>&gt; 13 g/dl = &gt; 8.0 mmol/l</td>
</tr>
<tr>
<td>Haematocrit</td>
<td>&gt; 38 %</td>
</tr>
<tr>
<td>Thrombocytes</td>
<td>&lt; 100 Gpt/l</td>
</tr>
<tr>
<td>A progressive decrease in platelet counts, even within the normal range, should be monitored within a few hours (Cave: HELLP syndrome, DIC).</td>
<td></td>
</tr>
<tr>
<td>GPT (ALT)</td>
<td>Rise above the normal range</td>
</tr>
<tr>
<td>GOT (AST)</td>
<td>Rise above the normal range</td>
</tr>
<tr>
<td>LDH</td>
<td>Rise above the normal range</td>
</tr>
<tr>
<td>Bilirubin (indirect)</td>
<td>&gt; 1.2 mg/dL = &gt; 20.5 µmol/l</td>
</tr>
<tr>
<td>Uric acid</td>
<td>&gt; 5.9 mg/dl = 350 µmol/l</td>
</tr>
<tr>
<td>Creatinine</td>
<td>≥ 0.9 mg/dl = 79.6 µmol/l</td>
</tr>
<tr>
<td>Protein in urine</td>
<td>≥ 300 mg/24 h</td>
</tr>
<tr>
<td>Haptoglobin</td>
<td>Drop below the normal range</td>
</tr>
<tr>
<td>Other clotting tests (e.g. rapid D-dimer increase (indicator of DIC))</td>
<td>Monitor</td>
</tr>
<tr>
<td>PIGF</td>
<td>Gestational age-specific standard value</td>
</tr>
<tr>
<td>sFlt-1/PIGF ratio</td>
<td>&gt; 85</td>
</tr>
</tbody>
</table>

6.3 Indications for hospital referral [11, 49, 93, 94]

- Hypertension ≥ 150 mmHg systolic or ≥ 100 mmHg diastolic
- Apparent preeclampsia
- Proteinuria and severe weight gain in the III trimester (≥ 1 kg/week)
- Impending eclampsia (Prodromal symptoms: upper abdominal pain, nausea, vomiting; CNS symptoms: visual snow, persistent headache, hyperreflexia)
- Clinical suspicion of HELLP syndrome, especially persistent upper abdominal pain
- Indicators of a threat to the fetus
  - Suspicious/pathological CTG or suspicious/pathological Doppler scan
  - IUGR
- Mild hypertension or proteinuria and further risk factors such as
  - Pre-existing maternal disorders (e.g. diabetes mellitus)
  - Multiple pregnancy
  - Early gestational age (< 34 weeks)
  - An-/Oligohydramnios
  - Pathological sFlt-1/PIGF ratio

6.4 Measures to be taken in hospital

6.4.1 On admission

- Diagnosis of maternal and fetal condition (hypertensive or fetal emergency?):
  - Fastest possible measurement of blood pressure on admission (repeat after adaptation phase if necessary) followed by close blood pressure measurement until stabilisation of blood pressure
  - Exclusion of prodromal symptoms (central symptoms, upper abdominal pain)
  - CTG recording (from fetal viability)
  - Proteinuria diagnosis using test strips on admission and as part of quantitative protein measurement
  - Laboratory according to hospital standard (see Table 4)
  - Ultrasound (biometry/Doppler scan)

6.4.2 After stabilisation

- Blood pressure monitoring depending on clinical symptoms
- CTG (1–3 ×/day)
- Laboratory monitoring daily up to 2 × per week (determination of angiogenic factors (sFlt-1/PIGF ratio) for differential diagnosis/short-term prognosis if necessary)
- Monitoring of clinical symptoms, especially upper abdominal pain, headache, blurred vision, hyperreflexia, (check reflex status), impairment of consciousness, dyspnoea, increased risk of bleeding
- Hourly monitoring of urine output in pregnant women with severe clinical symptoms of preeclampsia, pulse oximetry for respiratory symptoms (for example, dyspnoea)
- Fetometry every 10–14 days and measurement of amniotic fluid volume
- Doppler scan daily/weekly
- RDS prophylaxis (24 to 34 weeks) – individualised decision
- Daily weight monitoring

7 Treatment

7.1 Basic aspects of drug treatment

Initiation of drug treatment should be the sole responsibility of the hospital, since inpatient observation under controlled conditions may result in the need for a blood pressure lowering drug. This continues to be problematic in terms of fetal development.
Table 5  Long-term treatment with oral antihypertensives [95, 101–103] as at 12/2013.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Dose</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suitable</td>
<td>Alpha-Methylldopa 250–500 mg oral (bd – qds) max. 2 g/day</td>
<td>First choice</td>
</tr>
<tr>
<td>Partially suitable</td>
<td>Nifedipine retard 20–60 mg ret. oral max. 120 mg/day</td>
<td>No proven teratogenic effects</td>
</tr>
<tr>
<td></td>
<td>Selective β-1 receptor blocker (Metoprolol agent of choice) Dose 25–100 mg (bd)</td>
<td>Increased risk of fetal growth restriction generally with β-blocker therapy</td>
</tr>
<tr>
<td>Not suitable</td>
<td>Diuretics</td>
<td>Potential impairment of uteroplacental perfusion from additional plasma volume reduction</td>
</tr>
<tr>
<td></td>
<td>ACE inhibitor</td>
<td>No proven teratogenic effects. Contraindicated in II/III trimester: Acute renal failure in neonates, oligohydramnios</td>
</tr>
<tr>
<td></td>
<td>Angiotensin AT1 antagonists</td>
<td>Oligohydramnios, skull hypoplasia, potentially teratogenic in analogy to ACE inhibitors and nephrototoxic for the newborn</td>
</tr>
<tr>
<td>All other antihypertensives</td>
<td></td>
<td>Insufficient information on use in pregnancy</td>
</tr>
</tbody>
</table>

Cave: Dihydralazine is not recommended because of severe maternal side effects (reflex tachycardia, headache, tachyphylaxis).

and should therefore not be initiated below a persistent blood pressure of ≥ 150 mmHg systolic and/or ≥ 100 mmHg diastolic and at the latest at a value of ≥ 160/110 mmHg [6, 11, 95]. The target blood pressure levels should be < 150 mmHg systolic and 80–100 mmHg diastolic [11]. According to current knowledge, antihypertensive treatment in severe hypertension is used to prevent maternal cerebrovascular/cardiovascular complications. The focus is on prevention of cerebral haemorrhage and supplementation with i. v. magnesium is required for effective eclampsia prophylaxis [96–100]. A benefit for fetal development and therefore improvement of the baby’s prognosis by drug blood pressure reduction has not yet been proven. Patients with infertility and chronic hypertension should be treated with drugs that are indicated in pregnancy [11, 20]. The physiological blood pressure in the first half of pregnancy has to be considered when drug treatment is used to control chronic blood pressure in pregnancy (dose reduction or discontinuation of medication if necessary).

7.2 Long-term treatment with oral antihypertensive agents

If general measures do not succeed in keeping the blood pressure at < 150/100 mmHg, antihypertensive drug therapy must be initiated or intensified or pre-existing medication must be resumed. Potential effects on fetal development must be considered when considering the choice of antihypertensive agent (see Table 5).

7.3 Treatment of severe hypertensive pregnancy disorders

7.3.1 Antihypertensive treatment

Initial antihypertensive treatment of severe hypertension (blood pressure ≥ 160/110 mmHg) should be carried out under CTG monitoring, as a pronounced drop in blood pressure may be associated with an acute threat to the fetus. Patients should be closely monitored and regular blood pressure checks (at least once every 10–15 min) are necessary [15, 104]. The diastolic target blood pressure should not fall below 80–100 mmHg [11, 97, 104]. A severe hypertensive pregnancy disorder is present if hypertension cannot be successfully treated with oral hypertensives (s. 6.2) or a hypertensive emergency exists. A hypertensive emergency (prolonged acute severe hypertension for over 15 min with vital hazards caused by organ damage, e.g. hypertensive encephalopathy with blurred vision, dizziness, severe headache, decreased consciousness, neurological deficits or pulmonary oedema) requires immediate drug treatment to reduce blood pressure [71, 104, 106, 107]. The medication available in Germany, nifedipine and urapidil, can both be used without preference for the initial treatment of severe hypertension [103, 108]. However, the off-label use of nifedipine and urapidil must be observed (see Table 6).

Dihydralazine is approved for antihypertensive therapy during pregnancy; however it has significantly more maternal side-effects than urapidil (especially severe headaches, reflex tachycardia), which can complicate the differential diagnosis in relation to the progression of preeclampsia [108, 109]. According to a meta-analysis, dihydralazine is associated with a higher rate of maternal side-effects (including severe hypotension) and perinatal complications (including placental abruption) compared to nifedipine, without a definitive assessment being possible according to the authors [110, 111]. To reduce the risk of sudden severe hypotension with subsequent risk to the fetus, up to 500 ml of intravenous electrolyte solution should be infused prior to the administration of dihydralazine [11].

7.3.2 Anticonvulsive treatment

The treatment of choice for the prevention of eclampsia is the intravenous administration of magnesium sulphate which is indicated in severe preeclampsia, especially where there are central nervous system symptoms, as a significant reduction in the risk if eclampsia can be achieved with magnesium sulphate [112–116]. The effectiveness of this seizure prophylaxis is less clear for mild preeclampsia, but is under discussion after a large-scale study with > 10 000 pregnancy women with mild and also with severe preeclampsia showed a halving of the eclampsia risk with magnesium sulphate (1 g/h) compared to placebo [99, 117, 118]. Magnesium sulphate is also the drug of first choice in manifest eclampsia [112–116]. Superiority over phenytoin as well as diazepam in the prevention of re-convulsions and in terms of neonatal results has also been shown [112, 114, 115, 119]. Intravenous therapy (see Table 5) is with a loading dose of 4–6 g of diluted magnesium sulphate administered over 15–20 min via syringe driver or short infusion and continued with a maintenance dose of 1 g/h [120].
The patient should be closely monitored and the reflex state (patellar reflex), respiratory rate (should not fall below 12 breaths/min) and renal function (at least 100 ml excretion within 4 hours) generally suffice here. Calcium should be readily available for immediate intravenous injection as an antitode (1 vial = 10 ml of i.v. calcium gluconate 10% slowly over 3 min). Alternatively, anticonvulsant therapy with diazepam or phenytoin can be given if transport is in the ambulance.

### 7.3.3 Volume expansion

Accompanying volume therapy has not shown any treatment advantages in previously conducted randomized trials [121, 122]. Sufficient oral volume intake should be maintained.

### 8 Indications for delivery

Delivery is the only causal therapy for pregnant women with pre-eclampsia. Prolongation of the pregnancy is primarily to prevent preterm birth and assumes an expected benefit for the baby. The assessment of the risk and the potential benefit of watchful waiting approach must be continuously reassessed, taking into account all maternal and fetal changes. In addition to the considerable importance of gestational age, the question of completed pregnancy beyond the 37th week of pregnancy is usually indicated after the 37th completed week of pregnancy [11, 12, 72, 123].

#### 8.1 Pre-eclampsia after the completed 34th to 37th week of pregnancy (34 + 0 to 36 + 6 weeks)

After the completed 34th week, every patient with severe preeclampsia should be delivered as soon as possible [8, 11]. This also applies in cases of severe fetal growth restriction < 5th percentile with concurrent pathological fetal or fetal-placental blood flow such as absent or reversed flow in the umbilical artery [124–132].

However, of lesser importance is the amount of amniotic fluid which, compared to IUGR, appears to have no isolated effect on pregnancy outcome in preeclampsia [133, 134]. Prolongation of pregnancy beyond the 37th week is not advisable in mild pre-eclampsia [139]. Significant fetal weight reduction is not observed in mild preeclampsia [139].

#### 8.2 Pre-eclampsia after the completed 24th to 34th week of pregnancy (24 + 0 to 33 + 6 weeks)

Patient care should take place in a perinatal centre. A primary conservative approach is recommended because there are hardly any serious effects on the mother, but clear benefits for the child can be expected under continuous monitoring [140–142]. A fundamentally similar approach appears justifiable for HELLP syndrome [143, 144]. Severe fetal growth restriction < 5th percentile alone does not constitute a clear indication for delivery in cases of severe preeclampsia before the 34th week as long there are no highly pathological Doppler results [127, 132, 145].

The assessment of the risk and the potential benefit of watchful waiting approach must be continuously reassessed, taking into account all maternal and fetal changes. In addition to the considerable importance of gestational age, the question of completed pregnancy is usually indicated after the 37th completed week of pregnancy [11, 12, 72, 123].

Significant maternal and perinatal morbidity and mortality are to be expected [147–149]. The decision to continue the pregnancy should be made individually. The focus is on the avoidance of maternal complications.

#### 8.4 Method of delivery

Vaginal delivery can be tried if the maternal and fetal conditions are stable as there is no increased risk to the baby with optimum monitoring. The severity and the dynamics of the disease and the chances of success of a vaginal birth (e.g. cervical ripening) should be considered when deciding on the method of delivery [151, 152].
9 Postnatal care

Cave: Postpartum HELLP syndrome (7–30%) and postpartum eclampsia (up to 28%) [68, 153].
- Continuation of intensified monitoring up to 48 hours postpartum
- In severe preeclampsia: magnesium sulphate i.v. up to 48 hours postpartum
- Blood pressure monitoring postpartum until normalisation of blood pressure; guidance on self-monitoring of blood pressure [154]
- Target blood pressure on discharge < 150/100 mmHg
- Tapered dose reduction or alteration of antihypertensive treatment

9.1 Drug treatment
- In pregnancy-associated hypertension, tapered dose reduction of antihypertensive drug treatment is usually possible within 3 days to 6 weeks postpartum in most cases.
- If blood pressure has not normalized up to 6 weeks postpartum: diagnosis and treatment as recommended by the German Hypertension Society [155, 156].
  Continuation of ongoing treatment or conversion to oral medication if necessary (metoprolol, nifedipine, alpha-methyldopa) [103, 156].

9.2 Breast feeding
Discontinuation of breast feeding because of an antihypertensive drug treatment is usually not necessary with the large selection of antihypertensives which are compatible with breast feeding [103].

9.3 Counselling
A final discussion with the patient about the disease, the individual course and other consequences is essential, in the presence of her partner if possible, with the offer of meeting again, e.g. before planning/occurrence of another pregnancy [157, 158]. Referral should be made to self-help groups, e.g. Arbeitsgemeinschaft Gestose-Frauen e.V. (Women’s Gestosis Working Group, www.gestose-frauen.de), Bundesverband der Frühgeborenen e.V. (Federation of Premature Babies e.V., http://www.fruhegeborene.de) and European Foundation for the Care of Newborn Infants (EFCNI: www.efcni.org; www.enemenemini.eu/de/Home). Use of oral contraception is possible after preeclampsia/HELLP syndrome [159].

10 Care after preeclampsia

10.1 Further diagnostics after the postpartum period
- Measurement of serum creatinine and proteinuria, including microalbuminuria, proteinuria ideally from a 24 h urine collection
- Evaluation of possible kidney damage 3 months postpartum [160–163]
- Referral to a nephrologist if there is persistent proteinuria and/or increased serum creatinine
- In severe preeclampsia – clarification of antiphospholipid syndrome/systemic lupus erythematosus [164]

10.2 Follow-up of infants
Monitoring and follow-up is based on the general guidelines. This particularly applies to growth-retarded infants and premature births. An additional examination of sensory integration disorders should be planned the first year of life and also for full-term infants or for infants born after 34 weeks. Another additional examination is recommended in the third year of life, preferably in a socio-paediatric centre.

10.3 Future life – planning further pregnancies
- Point out to the patient the increased risk of cardiovascular disease for both mother and child [165–183]
- Inform the patient about the risk of recurrence after preeclampsia/HELLP syndrome (see above) [65, 67, 184–188]
- Diagnosis and treatment where appropriate of cardiovascular risk factors (nicotine, blood lipids, diabetes, metabolic syndrome, lifestyle changes) [167, 170, 174, 176]
- Consultation (internist, gynaecologist) before planned pregnancy (including prevention) [162, 189, 190]

11 Special features of HELLP syndrome

11.1 Diagnosis
The diagnosis is made by laboratory tests with evidence of the triad of haemolysis, elevated liver enzymes and thrombocytopenia [191]:
- (H): haemoglobin (↓)
- (EU): elevated liver enzymes (Transaminases ↑ [GOT, GPT])
- (LP): low platelets (Thrombocyte count ↓ [< 100 G/l])

The following clinical symptoms can occur simultaneously [164, 192]:
- Right-sided upper abdominal pain/epigastric pain: > 90%
- Hypertension: 80%
- Proteinuria: up to 15%
- Both proteinuria and hypertension may be missing in HELPP syndrome (HELLP syndrome without preeclampsia)
- Possible neurological symptoms

11.1.1 Laboratory parameters
Clinical chemistry tests should initially be repeated at 6–8 hourly intervals, especially when they are only discrete at the start of the disorder or are not completely altered in terms of the classic triad [164, 193].

Evidence of haemolysis is best performed by determining haptoglobin (decreased in 95–97% of patients, the most sensitive parameters of haemolysis) [164, 193–199]. Further haemolysis parameters [164]:
- Detection of fragmentocytes in a peripheral blood smear (54–86%)
- Total bilirubin raised (47–62%)
- LDH is not a haemolysis-specific parameter in HELLP syndrome [164, 192, 196, 197]; however it correlates with the severity of the disease [200].

An increase in C-reactive protein is detected in up to 62% of cases of HELLP syndrome and is not a result of infection [199, 201–205].

11.1.2 Pain symptoms
Right-sided upper abdominal pain/epigastric pain may occur with HELLP syndrome, even before laboratory evidence of HELLP syndrome. Pain may also be retrosternal. If right upper quadrant abdominal pain or retrosternal pain occurs after the 18th week, HELLP syndrome must be excluded in the differential diagnosis or confirmed.

11.1.3 Clinical course
Fluctuating in spurts, with possible remissions in up to 46% of cases or exacerbation within hours [143], in particular the development of coagulopathy (DIC) occurs more often than with preeclampsia (no heparin administration, haemostasis correction with fresh frozen plasma if necessary) [153, 164, 193].
11.1.4 Indications for delivery
Fetal indications for delivery

The indications for delivery of a fetal perspective correspond with the general indications for delivery (see. Chap. 8) using the recognised diagnostic methods (Doppler sonography, biometrics, CTG, fetal heart rate variability) taking into account the gestational age.

Maternal indications for delivery

The indications for delivery from a maternal perspective are based on the maternal condition. With the aim of reducing neonatal morbidity and mortality, a conservative approach – preferably in a perinatal centre [206] – is recommended at a gestational age of below 34 weeks, at least until clinical stabilization [19,141,143,164,206–210]. The indications for immediate ending of a pregnancy are based on the maternal and fetal indications of severe preeclampsia. A pregnancy should be ended especially if there is associated, severe or treatment-refractory preeclampsia, disseminated intravascular coagulation (DIC), severe renal insufficiency, congestive heart failure or pulmonary oedema [19,143,164,206,208].

Logistical requirements for prolongation of a pregnancy are the intensive monitoring of mother and child, the availability of frequent laboratory controls, the possibility of immediate ending of the pregnancy by Caesarean section and close interdisciplinary cooperation with neonatology and anesthesiology. The therapeutic approach to stabilize the maternal situation is generally based on the criteria described for severe preeclampsia [193,208,210].

If HELLP syndrome is confirmed, pregnancy should be ended after 34 weeks of pregnancy. A vaginal delivery can be tried if the maternal and fetal conditions are stable. There is currently insufficient clinical experience for induction of labour (e.g. with prostaglandins) in HELLP syndrome. It should be noted that when HELLP syndrome occurs, the cervix is often unripe and the duration and success of labour induction are therefore unforeseeable [193,208,210].

Induction of labour is generally possible if all the above criteria are taken into account.

11.1.5 Special features of treatment
Glucocorticoids are increasingly used as part of the prolongation of pregnancy according to the following treatment regimens [206,211–214]:

- Methylprednisolone (Urbason®) 32 mg/day i.v. (or increased dose if necessary)
- Dexamethasone 2–3 × 10 mg/day i.v.

Cave: Methylprednisolone does not readily cross the placenta, therefore additional lung ripening therapy is necessary (e.g., betamethasone) [197,215–217].

In the majority of studies, glucocorticoids used ante- or postpartum resulted in clinical and biochemical remission of differing durations (the majority of studies used dexamethasone) [164,211,213,214,219–232].

In contrast, a placebo-controlled double-blind study found that glucocorticoids had no effect [233]. According to a Cochrane analysis, there is currently insufficient data available regarding a benefit for the fetal/maternal outcome and the uncritical use of corticosteroids is not recommended [234].

11.1.6 Follow-up after HELLP syndrome

HELLP syndrome is not a contraindication for further pregnancies [159,164,189]. Use of oral contraception is possible. The recurrence risk is increased compared to women after uncomplicated pregnancies and is between 2 and 19% [67,159,164,187,188,235,236]. Early HELLP syndrome (<32 weeks) appears to be accompanied by an increased risk of a recurrence of early HELLP syndrome [235]. According to a Germany-wide study, the risk of HELLP syndrome after HELLP syndrome is 12.8%; the risk of other hypertensive disorders during the pregnancy is 30.4% [67]. In subsequent pregnancies, the administration of low-dose aspirin is indicated (100 mg/day) from early pregnancy. Patients should be monitored according to the criteria of a high-risk pregnancy after HELLP syndrome.
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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. med. Diethelm Wallwiener
Universitätsfrauenklinik Tübingen
Calwerstraße 7
DE-72076 Tübingen

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

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

**Austrian Society of Gynecology and Obstetrics**
*(Österreichische Gesellschaft für Gynäkologie und Geburtshilfe [OEGGG]*)

Innrain 66A
AT-6020 Innsbruck
stephanie.leutgeb@oegg.at
http://www.oegg.at

**President of OEGGG**
Prof. Dr. med. Uwe Lang
Universitätsklinik für Frauenheilkunde und Geburtshilfe Graz
Auenbruggerplatz 14
AT-8036 Graz

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

**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 fetomaternale Medizin
Inselspital Bern
Effingerstraße 102
CH-3010 Bern