Criteria for placental examination for obstetric and neonatal providers

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Abstract

Pathologic examination of the placenta can provide insight into likely (and unlikely) causes of antepartum and intrapartum events, diagnoses with urgent clinical relevance, prognostic information for mother and baby, support for practice evaluation and improvement, and insight into advancing the sciences of obstetrics and neonatology. While it is true that not all placentas require pathologic examination (although alternative opinions have been expressed), prioritization of placentas for pathological examination should be based on vetted indications such as maternal comorbidities or pregnancy complications in which placental pathology is thought to be useful for maternal or infant care, understanding pathophysiology, or practice modifications. Herein we provide placental triage criteria for the obstetric and neonatal provider based on publications and the expert opinion of sixteen placental pathologists and a pathologists’ assistant using a modified Delphi approach. These criteria include those indications in which placental pathology has clinical relevance such as pregnancy losses, maternal infection, suspected abruption, fetal growth restriction, preterm birth, non-reassuring fetal heart testing requiring urgent delivery, preeclampsia with severe features, or neonates with early evidence of multiorgan system failure including neurological compromise. We encourage a focused gross examination by the provider or an attendant at delivery for all placentas and provide guidance for this examination. We recommend that any placenta which is abnormal on gross examination undergo a complete pathology examination. Additionally, we suggest practice criteria for placental pathology services including a list of critical values to be called in to the relevant provider. We hope these sets of triage indications, criteria, and practice suggestions will facilitate appropriate submission of placentas for pathologic examination and improve their relevance to clinical care.
Introduction

The practices of obstetrics and neonatology include a diverse spectrum of clinical situations from pre-pregnancy to post-partum and from fetus to infant. Pregnancy and its complications play a role in the immediate and future health status of both the mother and the infant. \(^1\)\(^-\)\(^7\) The pathological investigation of the placenta can offer clinical value in these situations. It is a readily available specimen that, when properly examined and reported, can provide insight into the antepartum and intrapartum events that can, with clinician input, help to explain immediate outcomes and provide prognostic information for the health of both the mother and the infant. \(^7\)\(^-\)\(^15\) Given the unacceptably high and racially biased maternal mortality\(^16\) and stillbirth\(^17\) rate in the United States, insight into their causes as identified by placental pathology, might suggest avenues for much needed intervention. These are just a few reasons why placental pathology is an important part of perinatal care.

The placental pathologic examination differs from the usual surgical pathology specimen in many respects. Placental findings reflect pathology from three separate sources: 1) fetal compartment, as it is the largest fetal organ, 2) maternal compartment, as the placenta is housed in, and perfused by, the mother, and 3) organ-specific abnormalities intrinsic to the placenta itself. All three of these components have relevance to the provider in terms of care of the mother or infant.\(^11\),\(^18\),\(^19\)

As not all placentas can have a full pathologic examination for cost, resource, and personnel considerations\(^18\), triage of placentas for submission for pathological examination should be based
on vetted indications that have the potential to provide insights into the short and long-term outcomes of both the mother and infant, informing about selected risks for future pregnancies, and adding value to the practice of obstetrics, neonatology, pediatric neurology, and clinical genetics. \(^{11, 20-22}\) These findings include those with immediate clinical utility, such as Candidal placentitis or a lysosomal storage disorder. The potential clinical benefits of placental examination, for clinical care and other purposes are listed in Table 1.

There are few expert derived criteria for placental pathologic examination in the United States, but a commonly referenced manuscript from authors affiliated with the College of American Pathologists (CAP) published in 1997 \(^{23}\) has guided many pathologists and clinicians over the years. In this manuscript Langston and colleagues specified criteria for provider triage of placentas for full gross and histopathologic examination. The authors also described protocols for the pathologic examination of the placenta, the reporting format for findings derived, and clinicopathologic correlations when available. Since 1997 there have been advances in our understanding of the relevance of placental pathology and updated indications for examination are thus warranted. A pool of expert placental pathologists, some members of the Perinatal or Practice Committees of the Society for Pediatric Pathology (SPP), and carefully chosen colleagues developed an initial draft guideline followed with input from professional societies that are stakeholders in maternal and perinatal health (the American College of Obstetricians and Gynecologists, the Society for Maternal-Fetal Medicine, and the American Academy of Pediatrics, Section on Neonatal-Perinatal Medicine) to revise and update the previously published 1997 CAP criteria herein.
Methods

The lead author selected sixteen perinatal pathologists practicing in the United States with expertise in placental pathology (including international status and a strong publication record) and one pathologists’ assistant with publication and expertise in placental pathology. A list of indications for the triage of placentas for gross and histopathologic examination based initially on the Langston et al criteria was expanded by inclusion of preexisting triage criteria used in England, Australia, other locations where details were published in English, and other criteria based on professional experience by the authors. This exhaustive list was then sent to all the authors for paring by exclusion and inclusion. An iterative process of honing the list followed, using a modified Delphi method of consensus (modified as the participants were not anonymized). The final consensus was based on an 80% agreement amongst the respondents (each criteria had to receive at least 80% of the respondents approving inclusion). Most triage criteria included herein received unanimous approval. An example of a criteria that resulted in much discussion and only 80% approval was preterm birth <37 weeks. Some authors preferred <32 weeks or <34 weeks. With iterative discussions we agreed on <37 weeks by an 80% approval and formulated and included that criterion in the final list. We gave all the respondents the option to withdraw as an author if they did not support the final triage criteria, but none did so.

After formulating the final list of accepted triage criteria, an initial draft of the manuscript was written, approved by all authors, and submitted to the relevant stake-holding societies for review in advance of their approval. The appropriate subcommittees of the Society for Pediatric
Pathology, the American College of Obstetricians and Gynecologists, the Society of Maternal-Fetal Medicine, and the American Academy of Pediatrics, each reviewed the draft of the manuscript and after reviewing it, offered suggestions and corrections resulting in changes to the initial triage criteria. Most changes suggested were to narrow or more completely specify the triage criteria. An example of this included changing the criteria of any maternal diabetes to only those with preexisting or poorly controlled diabetes. These comments and suggestions by the societies were incorporated into a revised draft of the manuscript that was re-circulated to the authors and received their unanimous approval. The societies then offered final acceptance of the manuscript (using the language of either “endorsement” or “support”).

Results

The triage criteria approved by our method with details as to the published literature’s support of each criterion and its benefit (per Table 1) are presented in Table 2. These 29 suggested triage criteria include important revisions (e.g. “severe” hypertensive disorders) and additions (e.g. maternal death, maternal malignancy, suspected fetal malignancy) to the 1997 CAP guidelines. These suggested triage guidelines require a focused gross examination of the placenta, as gross findings are a category for triage. We present Table 3 as a template for gross examination by the obstetric provider or a labor attendant. Some important findings both grossly and histopathologically that are critical values are presented in the supplemental materials (Supplemental tables S1 and S2) and shown in Figures 1 and 2.

Discussion
Despite recent commentary to the contrary, we hope that we have highlighted herein (as have others) that placental pathology provides important data for immediate clinical care, the development of clinical practice guidelines, clinician and family consolation, and prognostication for future health concerns of both mother and offspring (see Table 1 as well). While one could argue that all placentas should receive a full pathological examination for many reasons (including health care costs, hospital resources, available personnel), this is not practical. Therefore, criteria for triaging placentas for full pathological examination is essential.

Past triage criteria have lacked endorsement of all stakeholders, i.e. the professional societies most likely to utilize placental data. Herein we propose criteria tabulated by experts in placental pathology and supported by the American College of Obstetricians and Gynecologists, The Society of Maternal-Fetal Medicine, the American Academy of Pediatrics Section on Neonatal-Perinatal Medicine, and the Society for Pediatric Pathology. They are presented in Table 2. In these criteria we describe indications for triaging the placenta for a full pathologic examination based on maternal history, obstetric complications, fetal/neonatal outcome, and gross placental findings. These criteria have a robust evidence-based foundation which we believe should be considered for adoption by all institutions with obstetrics, neonatal-perinatal medicine, and pathology services. These criteria are recommendations not requirements. Each institution and practice should adapt (remove and/or add to) the list as they see fit for their service. For example, at the Massachusetts General Hospital we examine the placentas from all multiple gestations, whereas herein we recommend a more conservative approach - only for multiples with a complication.
These criteria require that all placentas receive a directed gross examination by the provider or a delivery attendant. The findings from the gross examination of the placenta with clinical information must be available to the provider for triage purposes including that from the mother, infant/fetus, and for the peripartum events. Gross examination of the placenta is not a time intensive procedure but does require that the attendant is comfortable with knowing what is and is not normal. A useful review of the placental gross examination for providers, Yeller’s 1998 manuscript \(^\text{36}\) is summarized in Table 3. Ideally, detailed description of placental findings should be documented in the delivery record. Institutions are encouraged to develop tools to make description and documentation of the gross placental examination easier to document. Images of important gross pathologic features that we recommend should prompt a full pathologic examination are presented in Figure 1. Some important histologic diagnoses are shown in Figure 2.

An important aspect to this discussion is the responsibility of the pathology services. The placenta is a unique specimen for surgical pathologists who typically have little training in perinatal pathology. No other organ has the adaptive qualities of the placenta (accommodating to the maternal environment by changing shape, implantation site, thickness, etc.) nor has the accelerated lifespan of 9 months over which dramatic gross and microscopic changes occur even in the normal placenta. Most institutions do not have a dedicated perinatal pathologist; therefore, a general surgical pathologist often covers the service, one who may not have been well trained in placental pathology. An unfortunate practice is to hold placentas as low priority specimens for both gross examination and histopathological diagnoses. This often leads to delayed reporting. It is not necessary to have a placental pathologist in all hospitals with an obstetric service, although
we do suggest that hospitals with more than 1000 deliveries a year have at least one pathologist with some additional training in placental pathology. This being said, we are pragmatic and understand that placental pathology is a specialty not available at many institutions. In such cases we advocate liberal use of consultants in the field. Providers are encouraged to discuss the placental pathology reports with the pathologists especially if there is discrepancy between the clinical assessment and the reported diagnoses. Providers and pathologists need to work together to improve the placental pathology service to optimize its clinical utility. We present in Table 5 and the supplemental material some suggestions for improving placental pathology services including placental handling, examination, storage, and dissemination of diagnoses and their clinical relevance. We provide Figure 2 with histopathologic examples of the 4 major placenta patterns of injury which should be known to all surgical pathologists reporting placental pathology.

We recommend retaining placentas that do not meet the criteria for pathologic examination for at least 72 hours after delivery when feasible. Placentas can be retained fresh at 4°C (preferred) or fixed in formalin and stored at room temperature. Delayed perinatal morbidity or early neonatal mortality can occur without indications at delivery for placental pathologic examination. Clearly these placentas may hold pathologic findings critical for the evaluation of cause, prognosis, and determining recurrence risk. If these placentas are not available for pathologic examination both families and providers will be left without a complete evaluation of the event. This may also lead to unnecessary litigious actions. Ideally, placentas that are not initially triaged for complete placental examination at delivery should be stored for at least 72 hours in the event that an
indication for placental examination emerges. This practice creates logistic difficulties and requires dedicated space and planning but is possible. For example, the Massachusetts General Hospital (with up to five thousand deliveries annually) has been retaining fresh placentas in the Pathology Department in a dedicated refrigerator without incident for more than 20 years. We retain these placentas for 10 days after delivery and have gone back to triage them on average twice a month for late development of indications: for example: late onset neonatal seizures or delayed post-partum hemorrhage. Most placentas are recovered within 72 hours of delivery and these refrigerated placentas do not suffer from the delay histopathologically. We encourage hospitals to assess whether storage of placentas is possible following delivery, develop processes for their storage, retrieval, and disposal, and implement this when feasible. However, if this is not possible, we recommend that hospitals optimize the process for identifying those placentas that require complete pathologic examination.

Finally, we would like to emphasize the importance of interpreting the placental pathology report with the family at the postpartum and early pediatric visits. Not only does this mitigate litigious risk but it helps the family understand aspects of the pregnancy and delivery for which they may have questions. This requires understanding by the providers of the placental pathology report. For this we recommend efforts both by the providers and the pathologist. We encourage providers to ask questions to the pathologists of any diagnoses or descriptions that are not clear or understood. Attending courses and inviting perinatal pathologist to give talks at providers’ institutions should also be encouraged. Pathologists should use standard diagnoses based on review of the four major patterns of placental pathology.
We believe our criteria are robust, easy to follow, and should be considered for implementation by all obstetric and neonatology providers in the United States. We respect the importance of clinical judgement in applying these criteria; they are not rules, but suggestions for best practice to be adapted to each individual situation. Although these criteria are presented for clinicians, we hope that pathologists will find this information useful for their practice as well.
Figure Legend

**Figure 1 Examples of gross pathology requiring triage of the placenta to full pathologic examination**

A: Discolored membranes from meconium exposure with tight true knot of the umbilical cord (Courtesy of James Moreno, Tara Mennefield, and Ona Faye-Petersen) B: Discolored membranes from acute chorioamnionitis (Courtesy of James Moreno, Tara Mennefield, and Ona Faye-Petersen) C: Fragmented placenta (Courtesy of Carolyn Polizzano) D: Placental mass – chorangioma (Courtesy of James Moreno, Tara Mennefield, and Ona Faye-Petersen) E: Velamentous insertion of the umbilical cord with thrombosed membranous and chorionic plate vessel (Courtesy of Carolyn Salafia) F: Non-acute abruption (Courtesy of James Moreno, Tara Mennefield, and Ona Faye-Petersen) G: Nodules on chorionic plate – amnion nodosum (Courtesy of James Moreno, Tara Mennefield, and Ona Faye-Petersen) H: Hypercoiled and discolored umbilical cord – intrauterine fetal demise (Courtesy of Drucilla J. Roberts)

**Figure 2 Histological examples of the 4 major patterns of placental injury**

Table 1  Clinical benefits of placental pathological examination (adapted from Chang \textsuperscript{38} and Langston et al \textsuperscript{23})

1. Augmentation with evidence to inform multidisciplinary clinical reviews such as morbidity and mortality conferences.
2. Identification of etiologies and pathological processes contributing to or causing an adverse pregnancy outcome including maternal death or pregnancy loss.
3. Improved management of subsequent pregnancies by identification of conditions known to have recurrence risks or which may be either treatable or preventable (Table 4).
4. Identification of a pathological condition requiring timely clinical intervention (Supplementary Tables).
5. Understanding of antenatal and intrapartum events that contribute to long-term neonatal morbidity and adult diseases/disorders with early identification of such changes making possible early interventions and improvement in long-term outcome.
6. Assessment of factors contributing to poor outcome based on factual data.
7. Understanding of antenatal and intrapartum events that contribute to long-term maternal morbidity such that interventions may improve outcome.
<table>
<thead>
<tr>
<th>Category and indication</th>
<th>Examples and references</th>
<th>Benefit category (as per Table 1)</th>
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<tbody>
<tr>
<td>Maternal death</td>
<td>Placental pathology aids in determining timing and severity of predisposing conditions (e.g., pre-eclampsia/toxemia (PET), or infection) or exacerbates/complicates the causational pathology (e.g. sepsis/coagulopathy/hemorrhage and placental intravascular organisms; maternal metastatic disease or intraplacental choriocarcinoma). Placental pathology can support or suggest a causational diagnosis, for example basal plate myometrial fibers and placenta accreta spectrum disorder. Placental pathologic examination is recommended in maternal death autopsy protocols and in the literature on determining its etiology.</td>
<td>1,2,6 For perinatal review/audit, diagnoses of pathological causes of adverse outcome, and factual findings of potential legal import.</td>
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<td>Diabetes - pregestational or poorly controlled</td>
<td>DM is associated with placental pathologies including fetal and maternal vascular malperfusion with immediate and long-term infant and maternal morbidity. Increased risk of villitis of unknown etiology and delayed villous maturation associated with stillbirth.</td>
<td>2,5,7 For diagnoses of pathological causes of adverse outcome, long-term offspring morbidity and long-term maternal morbidity.</td>
</tr>
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<td>Severe hypertensive disorder</td>
<td>Placental pathology can determine severity of</td>
<td>2,3,6,7 For diagnoses of pathological causes of adverse</td>
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<td>7</td>
<td>Infection during pregnancy or peripartum that is associated with congenital infection (e.g., intrauterine infection – chorioamnionitis, CMV, syphilis, ZIKA, COVID-19, etc.)</td>
<td>Hypertension and some features associated with neurocompromise in the infant. Some specific features are associated with development of maternal cardiovascular disease in the future necessitating cardiology care.</td>
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<td>8</td>
<td>Maternal systemic autoimmune disease including antiphospholipid antibody syndrome</td>
<td>Placental infection is risk factor for congenital infection. Placental pathology can make the diagnosis of specific infections* that may direct clinical care or explain perinatal death. Stages and grades of histologic evidence of infection related to perinatal morbidity.</td>
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<td>9</td>
<td>Metastatic malignancy</td>
<td>These diseases/disorders have a high associated with pathologies that have a significant recurrence risk and increased fetal/neonatal morbidity and mortality.</td>
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<tr>
<td>10</td>
<td>Obstetric indications</td>
<td>Metastatic malignancies* to the placenta can cross to the fetus and are associated with a poor outcome in the mother.</td>
</tr>
<tr>
<td>11</td>
<td>Antenatal bleeding in the second and third trimester</td>
<td>The cause of the antenatal bleeding can be include placental accreta spectrum/possibility of retained placenta, acute abruption with recurrence risk and chronic abruption with infant morbidity, all diagnosable by placental pathology.</td>
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<td>12</td>
<td>History of a previous placenta with pathology known to recur e.g. abruption, chronic histiocytic intervillitis, massive perivillous fibrin deposition/maternal floor</td>
<td>A history of a placental pathology with a known recurrence risk is associated with recurrence and often worsening of their pathology and its associated perinatal morbidities.</td>
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<td></td>
<td>Fetal Indications</td>
<td>Description</td>
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<tr>
<td>13</td>
<td>Pregnancy losses: miscarriage or stillbirth/intrauterine fetal demise</td>
<td>The etiology of pregnancy loss is placental in a large percentage of cases.</td>
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<td>14</td>
<td>Intrauterine growth restriction/fetal growth restriction (IUGR/FGR)</td>
<td>IUGR/FGR often has a placental cause and its etiology including specific infection*, placental pathology with recurrence risk; metabolic disorders* (e.g., storage disorders) can’t be diagnosed without placental pathology.</td>
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<td>15</td>
<td>Complications associated with multiple gestation</td>
<td>The etiology of fetal/neonatal weight discordance could include those associated with FGR and thus harbor recurrence risks. Placental pathology can offer specific diagnoses to assess management decisions. Confirmation by placental examination of cord entanglements and documentation of vascular anastomoses has etiologic value.</td>
</tr>
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<td>16</td>
<td>Hydrops fetalis</td>
<td>Placental pathology often can determine the etiology of the hydrops and provides a tissue source for special studies.</td>
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<tr>
<td>17</td>
<td>Severe fetal/placental anomaly</td>
<td>Placental pathology can diagnose or support a diagnosis of specific disorders e.g., amniotic band syndrome, triploidy, and transient abnormal myelopoiesis in Trisomy 21. Molar pregnancies, e.g. triploidy/partial hydatidiform mole, can be diagnosed and/or confirmed by placental pathology. The placenta is a source of tissue for special studies.</td>
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<tr>
<td>INTRAPARTUM INDICATIONS</td>
<td>Preterm delivery &lt;37 weeks</td>
<td>Suspected chorioamnionitis</td>
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<tr>
<td>The etiology or confirmation of a clinical diagnosis (e.g. chorioamnionitis) can be made by placental examination. Specific diagnoses can be made with placental pathology including maternal vascular malperfusion in cases complicated with pre-eclampsia, IUGR/FGR, or abruption for example. Some findings may provide prediction of recurrence of preterm birth. 69</td>
<td>Diagnostic confirmation, determination of specific infection*, stage/grade associated with perinatal risks of congenital infection and perinatal morbidity is an important part of placental pathology. 71</td>
<td>Acute abruption can be confirmed and its etiology, risk of maternal cardiovascular disease can be diagnosed by placental findings. 74</td>
</tr>
<tr>
<td>1, 2, 5 For diagnosis of pathological causes of adverse outcome, critical values, and those associated with long term morbidity of the neonate. 14, 72, 73</td>
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<tr>
<td>1, 2, 3, 6, 7 For perinatal review/audits, pathological causes of adverse outcome, recurrence risk, those of potential legal import, and those associated with long term maternal morbidity. 74</td>
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<tr>
<td>Table Entry</td>
<td>Description</td>
<td>Note</td>
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<tr>
<td>24</td>
<td>Retained placenta, rule out placenta accreta spectrum (PAS)</td>
<td>Placental examination can offer documentation of retained placenta and/or PAS and risk of future clinically significant PAS deliveries.</td>
</tr>
<tr>
<td>25</td>
<td>Post-partum hemorrhage</td>
<td>Some placental diagnosis give the etiology of post-partum hemorrhage including PAS, chorioamnionitis, and retained placenta.<strong>40</strong></td>
</tr>
<tr>
<td>26</td>
<td>Thick meconium</td>
<td>Meconium pigment in the placenta is documentation of the clinical diagnosis but the extent of meconium and its complications (meconium associated myonecrosis* and its associated perinatal morbidity and mortality<strong>77-79</strong>) requires a full pathologic examination.</td>
</tr>
<tr>
<td>27</td>
<td>Termination of pregnancy for obstetric or maternal indications</td>
<td>Examining the placenta in these terminations offers documentation/confirmation of the maternal diagnosis and that the pregnancy was terminated.</td>
</tr>
</tbody>
</table>

**POSTPARTUM INDICATIONS**

**28 Placental Indications**

**29 Any unusual findings in any aspect of the placenta gross examination by an experienced examiner (See Table 3 and ST1)** | Many placental gross pathologies have significant clinical implications, as a brief list of examples: discolored membranes suggest meconium staining or hemosiderin from chronic abruption or acute chorioamnionitis, discolored umbilical cord suggests meconium staining or a fetal inflammatory response, | 2 For diagnosis of pathological causes of adverse outcome. |
<table>
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<tr>
<th>30</th>
<th><strong>Neonatal Indications</strong></th>
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<tbody>
<tr>
<td><strong>31</strong></td>
<td>Compromised clinical condition at birth defined as any of the following: Apgar score of &lt;7 at 5 minutes, cord blood pH &lt;7, resuscitation &gt;10 minutes, severe anemia, persistent hypoglycemia, need for ventilatory assistance, neurological compromise (suspected HIE)</td>
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<td>The etiology of insult is often identified in the placenta and is occasionally of immediate clinical utility e.g., umbilical cord vascular thrombi, specific placental infections*, massive perivillous fibrin deposition/maternal floor infarct*, chronic histiocytic intervillositis*, lysosomal storage disorders*. Placental pathology can aide in determination of the timing of insult.</td>
</tr>
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<td></td>
<td>1,2,4,5,6 For perinatal review/audits, pathological causes of adverse outcomes, critical values, and those of potential legal import</td>
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<tr>
<td><strong>32</strong></td>
<td>Suspected neonatal sepsis</td>
</tr>
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<td></td>
<td>Specific infections can be identified and are of critical value.* Placental pathology can determine if the infection was transplacental.</td>
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<td>2,4,6 For diagnosis of pathological causes of adverse outcome, critical values, and factual findings of potential legal import</td>
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<td><strong>33</strong></td>
<td>Suspected meconium aspiration syndrome</td>
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<td>Placental pathology in this situation can offer documentation of the presence and approximate amount of meconium and determination of approximate timing of insult. 82-85 Other meconium associated pathologies with significant clinical importance can be diagnosed, e.g. meconium associated myonecrosis* and ulceration of the umbilical cord.*</td>
</tr>
<tr>
<td></td>
<td>1,2,6 For perinatal review/audits, pathological causes of adverse outcomes, and factual findings of potential legal import.</td>
</tr>
<tr>
<td>34</td>
<td>Anomalies not diagnosed antepartum</td>
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<tr>
<td>35</td>
<td>Neonate with known or suspected malignancy</td>
</tr>
<tr>
<td>36</td>
<td>Neonatal death</td>
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</table>

**Table 3** Gross examination of the placenta at delivery

*Denotes critical values

- Umbilical cord
  - length – if <35 (short) or >70 (long) cm at term, normal term length is 50-70 cm
  - color – white is normal, yellow is associated with chorioamnionitis, green with meconium, brown-red with retention of an intrauterine fetal demise of at least 6 hours
- coils – normal is 2 coils per 10cm. average of <1 or >4 is abnormal. Flat or hypercoiled cords are typically easily identified without precise measurements
- Ulcerations* or plaques (abscesses)* on the surface.
- True knot should be noted if present and described as to type (simple or complex) and tightness
- Number of vessels
- Velamentous, marginal, or furcate insertion of the umbilical cord

- Membranes
  - Membrane insertion should be predominantly marginal
  - Membranes should be thin and translucent, free of vessels or masses
  - Membrane color and clarity should be noted

- Disk
  - Size of the placenta <15cm in greatest diameter at term is likely small and >25cm is likely large, weight with membranes and umbilical cord attached (untrimmed) <400g or >700g at term is likely abnormal, thickness the placenta >4cm or <1.5cm is likely abnormal (most placental weight standards are for the trimmed placenta which we discourage the provider to do in anticipation of a potential full pathologic examination).
  - Placental completeness (evidence of disruption, possibly incomplete) should be noted
  - Note any adherent or parenchymal deforming blood clot(s)
  - Visible or palpable masses should be noted
Table 4 Placental pathology with a recurrence risk

1. Abruption $^{65}$
2. Chronic histiocytic intervillusitis $^{57}$
3. Massive perivillous fibrin deposition/maternal floor infarct $^{57}$
4. Villitis of unknown etiology $^{57}$

Table 5 Recommended practice guidelines for pathologists, obstetric and neonatal providers

1. All placentas should get a focused gross examination by the obstetric provider or an attendant at delivery to assist in triage. The findings of this examination should be given to the primary care provider in anticipation of placental triage. (Table 3)
2. Placentas should be triaged to pathology by the pregnant patient’s primary provider, with input from the neonatal provider (if present) and the findings from the gross examination of the placenta, for examination based on criteria as listed in Table 2.
3. Placentas should be sent fresh to pathology and stored refrigerated there until examined.
4. Placentas should be accompanied by pertinent maternal, obstetric, and fetal/infant histories.
5. We encourage that all placentas not submitted for pathologic examination be kept for at least 72 hours and made available for triage pending postpartum complications, if possible. Site for storage can be either be the labor floor or the pathology department. [These retained placentas can be safely stored “dry” at 4°C for 72 hours (and by MGH experience up to 2 weeks) without significant histologic artifacts. Retained placentas can alternatively be stored in formalin, at room temperature, as well also without significant histologic artifacts provided proper volume of formalin].
6. Triaged placentas should be examined fresh (if not infected with transmissible agents) and promptly by the pathology department. Placentas infected with transmissible agents should be fixed in formalin for 24+ hours prior to examination.

7. Placentas should be weighed, in the pathology department, trimmed of the umbilical cord, membranes, and any loosely accompanying blood. Comparison with site-appropriate published weight standards (see appendix A in ⁹⁴) by gestational age should be included in the report.

8. Special studies should be performed on the fresh placenta (stored refrigerated) as indicated by the history, e.g., microbiologic samples, tissue for genetic studies, injection studies (using milk or ink) to identify vascular anastomoses in twin gestations if needed (in diamniotic, monochorionic placentas).

9. We recommend liberal photography of grossly diagnosed abnormalities.

10. The Amsterdam Consensus guidelines ⁹⁵ and the four major patterns of placental pathologic diagnoses ³⁷ for sectioning/sampling and diagnostic criteria should be followed.

11. Keep a reasonable turnaround time for reporting by triaging sick neonates or mothers for rapid turn-around. We suggest reports finalized within 2 days for placentas (or providers be given a preliminary diagnosis within two days or sooner) from sick mothers or neonates (e.g. either in the ICU) or with gross placental findings of critical value (Table S1), and 3-4 days for the remaining “routine” placentas if possible.

12. The pathologist should have a low threshold for verbal discussion with either the obstetric or neonatal provider for critical values (see Supplemental materials) or complex diagnoses. Alternatively, the pathologist can provide interpretations of the diagnoses in
368 the report if the providers request. This practice should be decided on at an institutional
369 level.
370 13. The pathologist is encouraged to give at least annual presentations to the obstetrics and
371 neonatal services reviewing triage guidelines.
372 14. Pathology presentations at obstetrics and neonatal Morbidity and Mortality rounds is
373 recommended when germane.

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