Examination of the human placenta

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The human placenta is an underexamined organ. The clinical indications for placental examination have no gold standards. There is also inconsistency in the histological reports and the quality is variable. There is great interobserver variability concerning the different entities. Although there are still grey areas in clinicopathological associations, a few mainstream observations have now been clarified. The histopathological examination and diagnosis of the placenta may provide crucial information. It is possible to highlight treatable maternal conditions and identify placental or fetal conditions that can be recurrent or inherited. To achieve optimal benefit from placental reports, it is essential to standardise the method of placenta examination. This article summarises the clinical indications for placenta referral and the most common acknowledged clinicopathological correlations.

According to the guidelines of the Royal College of Pathology, samples of diagnostic value removed from the human body should be histologically examined, with only a few exceptions. One of the exceptions is the healthy human placenta, but even with valid indications the human placenta is one of the most underexamined specimens. There is also evidence that the quality of reports on the investigation of the placenta is very variable. According to a recent study, there is a considerable discrepancy rate in the diagnosis of placental disease, and it is common for general surgical pathologists not to recognise placental lesions that may have clinical relevance. In this best practice article, we summarise those circumstances in which it is recommended that the placenta should be examined, the minimum criteria of sampling, and the acknowledged clinicopathological correlations.

"It is common for general surgical pathologists not to recognise placental lesions that may have clinical relevance"

Lesions of the placenta often reflect or explain the condition in which the baby was born and some have clinicopathological implications. However, in most cases, there is no clinicopathological relevance to a placental examination, such as in the case of normal pregnancy and delivery.

CLINICAL APPROACH

What do we expect from the pathological examination?

The placenta forms a functional unit between the mother and the fetus. Therefore, any pathological event that concerns the mother or the fetus will influence the normal function of the placenta, occasionally resulting in morphological change. Severe abnormalities of the placenta may lead to adverse fetal outcome. However, placental lesions are not necessarily the cause of unfavourable outcome, and some structural changes may be the consequences of poor fetal condition. The placenta is an easily available specimen and the costs of a routine pathological examination are moderate.

The benefits that can be expected from the examination include revealing the aetiology of stillbirth, preterm delivery, intrauterine growth restriction (IUGR), and neurodevelopmental impairment. It may be possible to decide whether the pathological condition that endangered the well being of the fetus was an acute or a chronic process.

In the case of twin pregnancies, the type of twinning can be identified and pathological aspects of twin pregnancy (for example, twin-to-twin transfusion syndrome) can be studied.

Conditions with the risk of recurrence can be recognised, resulting in adequate treatment and preventive measures during subsequent pregnancies.

Placental examination may have medicolegal aspects—for example, concerning the aetiology of longterm neurodevelopmental sequelae or the approximate timing of an intrauterine death.

Which placentas should be examined?

There are different approaches to the examination of the placenta. It would produce a pointless increase in workload if all placentas, including those from normal pregnancies and normal deliveries resulting in a healthy infant, were examined in a routine pathology laboratory setting.

Because it is the decision of the midwife and/or obstetrician which placentas to send to the

Abbreviations: AAA, arterio–arterial anastomosis; AVA, arterio–venous anastomosis; IUGR, intrauterine growth restriction; VVA, veno–venous anastomosis
pathology department, a clinically oriented approach (fig 1) may be used to define the indications for histopathological examination.

Referral is not indicated for:

- cholestasis of pregnancy
- hepatitis B, human immunodeficiency virus, etc
- other maternal disease with normal pregnancy outcome
- normal pregnancy
- placenta praevia
- postpartum haemorrhage.

**Fetal conditions**
- IUGR (birthweight below 2.5 kg or 3rd centile)
- Prematurity (less than 37 weeks of gestation)
- Abruption
- Fetal hydrops
- Fetal abnormality, chromosome aberration
- Stillbirth
- Severe fetal distress requiring admission to NNU
- Rhesus (and other) isoimmunisation
- Morbidity adherent placenta
- Twins/other multiple pregnancy (uncomplicated)
- Abnormal placental shape (if clinically relevant, including placental tumours) or other postnatally diagnosed disorders of the placenta (haematoma, too big or too small placenta, infarction, discolouration of membranes)
- 2 vessel cord, etc
- Premature rupture of membranes (more than 36 hours)

**Diseases of the neonate with possible IU origin**
- Infection (pneumonia, sepsis within 72 hours)
- Neurological signs

**Maternal diseases that might have consequences in the neonate**
- Maternal pyrexia and maternal group B streptococcus
- Pre-eclampsia, hypertension
- Severe diabetes, including gestational diabetes, maternal thromboprophylaxis, other metabolic disease, autoimmune disease, tumour, storage disease, etc

**A RATIONAL SORTING OF THE REFERRED PLACENTAS**

Figure 2 is an algorithm for selecting which of the referred placentas should be subjected to further study. Figure 3 contains a recommendation for sampling the placentas based on the clinical context.

**NORMAL VARIANTS**

As mentioned above, many features can be judged only in the clinicopathological context. This is partly because of the loose correlation between some histological changes and clinical symptoms, and partly because of the large reserve capacity of the placenta.

To record the macroscopic appearance of the placenta we recommend the use of a worksheet as shown in fig 4. This proforma can be useful to describe normal placentas; however, each abnormality should be documented individually.

**Umbilical cord**

The normal length of the umbilical cord at term varies between 40 and 70 cm and cords of less than 32 cm are considered to be short and those more than 100 cm are considered long. The importance of length and coiling should be treated cautiously, because the proportion of the umbilical cord received in pathology laboratories varies and is thus not reliable. Umbilical cords normally show a degree of coiling. The normal coil index is said to be one coil/5 cm.91 0 The normal cord contains three vessels, and this has to be assessed at least 5 cm from the placental insertion.11 False knots may be the site of thrombosis, or rarely bleeding, but most often they have no clinical relevance.

Embryonic remnants of the vitelline duct and urachus are normal findings. Cysts may arise from these vestigial remnants. It may be necessary to differentiate the embryonic remnants of the cord from teratomas and haemangiomas.12

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**Figure 1** Indications for pathological referral of the placenta. IU, intrauterine; IUGR, intrauterine growth restriction; NNU, neonatal unit.

**Figure 2** An algorithm to sort the placentas in view of further action. CS, caesarian section; DOB, date of birth; LMP, last menstrual period.
Extraplacental membranes and the fetal surface

The importance of circummarginate and circumvallate placentas is uncertain, although an association with IUGR and acute and chronic maternal haemorrhage has been proposed in circumvallate placentas. Amnion nodosum (granular grey/white nodules, consisting of keratin and vernix) are a sign of oligo/anhydramnios, but squamous metaplasia of the amnion is a normal feature.

A small amount of subchorionic fibrin deposition (Langhans fibrinoid) is not pathological, because it accumulates from eddying of the intervillous flow.

Placenta

A low placental weight is found in “small for gestational age” placentas. Normal values of fetal to placenta weight ratio change during the course of gestation, and vary between 1 at 14 weeks and 7.23 at term. Hydrops or congestion can result in a high placental weight, but the placenta weight can vary to some degree (a table of normal values can be found in Benirschke and Kaufmann). Deviation from the round or oval shape such as an irregularly shaped, bilobed, or multilobed placenta can be attributed to disturbed implantation or uterine abnormalities, but it can be assessed only in the clinicopathological context. Increased calcification has been mentioned in association with maternal smoking and high socio-economic status, but the feature itself has no clinical relevance.

Minor perivillous fibrin deposition is almost always present in term placentas. This is of no clinical relevance if marginal, or if it does not exceed 10% of the villous tissue. A range of values is found in the literature with regard to the amount of the villous tissue loss required to define whether infarction or...
perivillous fibrin deposition is “extensive” or relevant—that is, large enough to account for adverse fetal outcome. The reported percentage of minimal villous tissue loss ranges from 10% to 30% in the case of significant placental infarcts and 20% to 30% in perivillous fibrin deposition. In general, there is no clinical relevance if the lesion is single, marginal, and/or involves less than approximately 5% of the villous tissue. Obviously, the functional reserve capacity of the placenta depends not only on the quantity, but also on the quality of the uninvolved tissue and the original size of the placenta. In the case of a small placenta, a smaller amount of parenchymal loss can lead to fetal demise or morbidity.

X cell islands (extravillous cytotrophoblast islands, X-cell proliferation) are considered to be a normal feature.

The origin of septal cysts is unknown. They are reported to occur more frequently in oedematous placentas, but are of no clinical relevance.

**Examination of twin placentas**

Twin placentas should be labelled after the delivery to identify which cord belongs to which fetus. The examination of placentas from multiple gestations should establish the chorionicity of the sample and whether there are signs of twin-to-twin transfusion syndrome. Separated twin placentas have to be examined in the same way as those of singletons. Fused placentas can be monochorionic or dichorionic. The dividing membrane should be studied to identify the chorionicity. The dividing membrane in monochorionic pregnancy is thin and translucent (with no...
Table 1  The clinical relevance of placental abnormalities

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Clinicopathological correlation</th>
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<tbody>
<tr>
<td>Umbilical cord</td>
<td>High fetal and neonatal mortality rates and increased frequency of neurological abnormality</td>
</tr>
<tr>
<td>Short cord (less than 40 cm)</td>
<td>Maternal factors: systemic diseases, delivery complications, increased maternal age</td>
</tr>
<tr>
<td>Long cord (longer than 70 cm)</td>
<td>Fetal factors: non-reassuring fetal status, respiratory distress, vertex presentation, cord entanglement, male sex, increased birth weight</td>
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<tr>
<td>Gross placental features: increased placental weight, overcoiled cord, true knots, congestion, cord prolapse causing fetal distress</td>
<td></td>
</tr>
<tr>
<td>Marginal cord insertion</td>
<td>IUGR, stillbirth, neonatal death, premature birth, low birth weight</td>
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<tr>
<td>Velamentous insertion</td>
<td>Fetal haemorrhage, fetal death, low birth weight, premature birth, maternal smoking, advanced maternal age</td>
</tr>
<tr>
<td>Overcoiling or undercoiling of the cord</td>
<td>Fetal demise fetal intolerance to labour, IUGR, chorioamnionitis</td>
</tr>
<tr>
<td>True knot</td>
<td>If tight, associated with perinatal mortality of 10% and umbilical vessel thrombosis</td>
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<tr>
<td>Single umbilical artery</td>
<td>Single umbilical artery is associated with fetal malformation chromosome aberration in 25–50% with IUGR and increased perinatal mortality in normally formed infants</td>
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<tr>
<td>Placenta praevia</td>
<td>Associated with high risk of third trimester bleeding</td>
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<tr>
<td>Associated with low placental weight, below 10th centile for gestational age</td>
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<tr>
<td>High placental weight</td>
<td>IUGR, pre-eclampsia, increased intervillous fibrin deposition, villitis of unknown origin, and trisomy</td>
</tr>
<tr>
<td>Thin placenta (placenta annulare or placenta membranacea)</td>
<td>Maternal diabetes mellitus, maternal or fetal anaemia, fetal hydrops; may also be seen in congenital syphilis, Beckwith-Wiedemann syndrome, congenital nephrotic syndrome</td>
</tr>
<tr>
<td>Placenta haemorrhage</td>
<td>Average thickness less than 2 cm, placenta with large membranous area. Risk of maternal bleeding, placenta praevia, placenta accreta. Often premature delivery occurs. Possibly more frequent in IUGR</td>
</tr>
<tr>
<td>Retroplacental haematomas</td>
<td>Large retroplacental haematomas can cause extensive infarction involving a sufficient proportion of the villous tissue to cause fetal death. Early separation is called abruptio placentae, and can be lethal if extensive. The AFP concentration may be raised if an old haematoma</td>
</tr>
<tr>
<td>Subchorionic haematomas (massive subchorial thrombosis, Bree’s mole)</td>
<td>This is a normal finding when patchy, focal, or diffuse. However, subchorionic thromboses of large size have been reported in association with abortion, premature delivery, and live-born infants also associated with high risk of third trimester bleeding</td>
</tr>
<tr>
<td>Placenta praevia</td>
<td>Potentially life threatening clinical conditions, causing uterine rupture and massive postpartum haemorrhage, or leading to caesarean section if prenatally diagnosed. It is often an indication of postpartum hystereotomy because of excessive bleeding. To make the pathological diagnosis of a placenta accreta, examination of the entire uterus is necessary</td>
</tr>
<tr>
<td>Placenta accreta, increta, and percreta</td>
<td>Increased numbers of syncytial knots occur in: pre-eclampsia, hypertension, diabetes mellitus, maternal anaemia, pregnancy at high altitude, thick section (artefact). A correlation between increased syncytial knotting and fetal hypoxia has not been reported. An excessive increase in syncytial knotting may result from reduced fetal perfusion and placental hypoxia or can be the sign of accelerated maturation if the duration of pregnancy was less than 40 weeks</td>
</tr>
<tr>
<td>Placental chorionic villi and intervillous space abnormalities</td>
<td>Infarct (acute or old)</td>
</tr>
<tr>
<td>Syncyial knots</td>
<td>No clinical relevance if it is single, marginal, and/or involves less than about 5% of the villous tissue</td>
</tr>
<tr>
<td>Involving more than 10% of villous tissue: fetal hypoxia, IUGR, stillbirth, pregnancy induced hypertension, abruptio placentae, neurological abnormalities</td>
<td></td>
</tr>
<tr>
<td>Villous basal membrane thickening</td>
<td>Raised numbers may occur in many causes of chronic hypoxia, IUGR, stillbirth, acute fetal blood loss, maternal diabetes, and erythroblastosis fetalis</td>
</tr>
<tr>
<td>VSM deficiency</td>
<td>An increase of VSM is described in pregnancies at high altitude, pre-eclampsia, maternal heart failure, and maternal anaemia. VSM deficiency was reported in pre-eclampsia, materno-fetal rhesus incompatibility, maternal diabetes, low birth weight and stillbirths</td>
</tr>
<tr>
<td>Villous villous fibrinosis and sclerosis</td>
<td>Extreme villous fibrinosis occurs in villous villous deficiency, in IUGR, and in avascular villi as a result of vessel thrombosis, and in CMV infection</td>
</tr>
<tr>
<td>Villous oedema</td>
<td>Placentas from pregnancies with hydrops fetalis may show a combination of immaturity and oedema. Villous oedema occurs in infections (syphilis, CMV, toxoplasma), in cases of fetal hydrops, and in hydralidiform moles. It is correlated with neurological impairment and cerebral palsy. May be normal if focal</td>
</tr>
<tr>
<td>Dysmaturity/immaturity</td>
<td>A failure of villous maturation was found to be associated with fetal hypoxia, IUGR, maternal diabetes, and materno-fetal rhesus incompatibility. Failure of maturation can lead to intrauterine death</td>
</tr>
</tbody>
</table>
outcome. Arterio–arterial anastomoses (AAA) may have a twin-to-twin transfusion manifests as discordant fetal neurological damage or the death of the co-twin. Chronic death of either of the twins, and frequently results in severe flow may lead to acute or chronic twin-to-twin transfusion. section is the best sample to prove chorionicity. Fetal vessel membrane roll or in ''T section'' form. A properly oriented T thicker, because it contains two chorionic layers between the chorionic layer), whereas that of a dichorionic placenta is NOS, not otherwise specified; RBC, red blood cell; SGA, small for gestational age; SLE, systemic lupus erythematosus; VSM, vascular–synchrony membrane; VUE, villi of unknown aetiology.

Table 1

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<tr>
<td>Advanced maturation/maturitas praecox</td>
<td>Accelerated maturation can be seen in prematurely delivered placentas in pre-eclampsia. It is considered to be an ischaemic feature. Associated with Beckwith-Wiederman syndrome.</td>
</tr>
<tr>
<td>Mesenchymal dysplasia</td>
<td>When more than 20–30% of the villous tissue and functional placenta is involved it is associated with IUGR and fetal death. In these cases often 70–80% of the villosa population is enveloped by fibrin. The maternal serum AFP values is raised, sometimes extremely so.</td>
</tr>
<tr>
<td>Perivillus fibrin deposition</td>
<td>Massive basal plate perivillus fibrin deposition is termed “maternal floor infarct” and is associated with high mortality and IUGR. Massive perivillus fibrin deposition in a netlike pattern is the “Gitter infarct”. Neither of these is an infarct. Massive perivillus fibrin can recur (18%) and is associated with IUGR and fetal death.</td>
</tr>
<tr>
<td>Maternal floor infarct</td>
<td>Clinical consequences depend on the type of the pathogenic agent. Acute villitis is usually associated with severe maternal infection, preterm delivery and might lead to intrauterine infection and IUD. Chronic villitis: more often of unknown aetiology (VUE) than known. Fetal infections causing chronic villitis: CMV, toxoplasma, congenital syphilis. Chronic villitis is associated with: IUGR and/or stillbirth.</td>
</tr>
<tr>
<td>Villitis</td>
<td>Associated with raised maternal serum AFP, recurrent abortion, IUGR, preterm delivery. Malaria infection should be excluded.</td>
</tr>
<tr>
<td>Acute villitis</td>
<td>Extensive avascular villi as a result of fetal vessel thrombosis was reported in association with stillbirth, IUGR, maternal and fetal coagulopathy, and fetal thromboembolic disease leading to cerebral palsy.</td>
</tr>
<tr>
<td>Chronic villitis: basal, parenchymal, granulomatous, and VUE</td>
<td>Neonatal asphyxia, association with disseminated capillary thrombi of fetal vessels. The severity of the fetal consequences depends more on the accompanying vascular lesions. Masses of villi with HEV was reported to be a postmortem artefact and was doubted as being a specific disease entity. HEV is considered to be an ischaemic feature.</td>
</tr>
<tr>
<td>Chronic histiocytic villitis, (chronic perivillitis)</td>
<td>When more than 20–30% of the villous tissue and functional placenta is involved it is associated with IUGR and fetal death. In these cases often 70–80% of the villosa population is enveloped by fibrin. The maternal serum AFP values is raised, sometimes extremely so.</td>
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<td>Abnormalities of the fetal vessels</td>
<td>Massive basal plate perivillus fibrin deposition is termed “maternal floor infarct” and is associated with high mortality and IUGR. Massive perivillus fibrin deposition in a netlike pattern is the “Gitter infarct”. Neither of these is an infarct. Massive perivillus fibrin can recur (18%) and is associated with IUGR and fetal death.</td>
</tr>
<tr>
<td>Fetal chorionic vessel thrombosis and avascular villi; stem vessel thrombosis (single/or multiple); recanalisation of chorionic vessels; Intimal fibrin cushion</td>
<td>Extensive avascular villi as a result of fetal vessel thrombosis was reported in association with stillbirth, IUGR, maternal and fetal coagulopathy, and fetal thromboembolic disease leading to cerebral palsy.</td>
</tr>
<tr>
<td>HEV and haemorrhagic villitis</td>
<td>Uteroplacental or decidual arteriopathy is closely related to pregnancy induced hypertension, maternal essential hypertension, and pre-eclampsia, and results in fetal complications such as IUGR, SGA, and stillbirth. It is associated with APA, SLE, and thrombophilia.</td>
</tr>
<tr>
<td>Abnormalities of the maternal vessels</td>
<td>Most often intervillus haemorrhage is related to a maternal vessel lesion and is of maternal origin. Its consequence can be fetal compromise or death depending on the functional placenta parenchyma loss and the rest of the unaffected placenta.</td>
</tr>
<tr>
<td>Failure of physiological adaptation of maternal vessels, uteroplacental vessel fibrinoid necrosis, acute atherosclerosis, uteroplacental vessel thrombosis</td>
<td>In some cases, intervillus haemorrhage and thrombus is a sign of fetal bleeding into the maternal circulation, as described by Kline. Only a few of these alterations lead to a large amount of fetal blood loss and stillbirth or severe anaemia followed by ischaemic lesions of parenchymal organs. It is important to know the type of twinning because the twin-to-twin transfusion syndrome is associated with diaphragmatic monochorionic placentas.</td>
</tr>
<tr>
<td>Haemorrhages of the placenta</td>
<td>Associated with raised AFP, fetal DIC, and fetal hydrops; fetal death has been described associated with pre-eclampsia, multiple gestation, premature delivery, fetal thrombocytopenia, and fetal angiomatosis (Kasabach-Merritt syndrome). The lesion can be associated with raised AFP, fetal DIC, and fetal hydrops; fetal death has been described too.</td>
</tr>
<tr>
<td>Intervillous haemorrhage and intervillous thrombus</td>
<td>Massive perivillous fibrin can recur (18%) and is associated with IUGR and fetal death. In these cases often 70–80% of the villosa population is enveloped by fibrin. The maternal serum AFP values is raised, sometimes extremely so.</td>
</tr>
<tr>
<td>Kline’s haemorrhage</td>
<td>Large lesions often lead to cardiac failure, hydrops, and death of the fetus. Transplacental bleeding and fetomaternal transfusion have also been described, leading to anaemia. Charangioangioma was reported to be associated with pre-eclampsia, multiple gestation, premature delivery, fetal thrombocytopenia, and fetal angiomatosis (Kasabach-Merritt syndrome). The lesion can be associated with raised AFP, fetal DIC, and fetal hydrops; fetal death has been described too.</td>
</tr>
<tr>
<td>Twin placenta, chorionicity</td>
<td>Necrotising villitis: basal, parenchymal, and VUE often associated with pre-eclampsia, IUGR, and fetal growth restriction; NOS, not otherwise specified; RBC, red blood cell; SGA, small for gestational age; SLE, systemic lupus erythematosus; VSM, vascular–synchrony membrane; VUE, villi of unknown aetiology.</td>
</tr>
<tr>
<td>Angiomas</td>
<td>Extensive avascular villi as a result of fetal vessel thrombosis was reported in association with stillbirth, IUGR, maternal and fetal coagulopathy, and fetal thromboembolic disease leading to cerebral palsy.</td>
</tr>
<tr>
<td>Angioma of the placenta (chorangioma)</td>
<td>Uteroplacental or decidual arteriopathy is closely related to pregnancy induced hypertension, maternal essential hypertension, and pre-eclampsia, and results in fetal complications such as IUGR, SGA, and stillbirth. It is associated with APA, SLE, and thrombophilia.</td>
</tr>
<tr>
<td>Angioma in the cord</td>
<td>Most often intervillus haemorrhage is related to a maternal vessel lesion and is of maternal origin. Its consequence can be fetal compromise or death depending on the functional placenta parenchyma loss and the rest of the unaffected placenta.</td>
</tr>
</tbody>
</table>

**Note:** AFP, a fetoprotein; APA, anti-phospholipid syndrome; CMV, cytomegalovirus; DIC, disseminated intravascular coagulopathy; HEV, haemorrhagic endovasculitis; IUD, intrauterine death; IUGR, intrauterine growth restriction; NOS, not otherwise specified; RBC, red blood cell; SGA, small for gestational age; SLE, systemic lupus erythematosus; VSM, vascular–synchrony membrane; VUE, villi of unknown aetiology.

“A properly oriented T section is the best sample to prove chorionicity.”
It is recommended that fused dichorionic placentas should be separated. Evidence of a vanished twin might be found in singleton or twin placentas. This varies in appearance from an amorphous, fibrotic plaque to a well formed fetus pappayose. Histological and x-ray examinations are helpful to identify calcification.16

RECOGNISED CLINICOPATHOLOGICAL CORRELATIONS

Table 1 summarises the clinical relevance of placental abnormalities.

CONCLUSION

We recommend that relevant placentas are discussed regularly at perinatal mortality or morbidity meetings. This could reveal new clinicopathological correlations, would increase appreciation of the profession, and would serve team building and communication between the different medical teams. We have presented an algorithm of indications for placental examination and discussed the methods of histopathological examination. Common placental lesions with their clinicopathological correlation are reviewed. Our intent is to outline the acknowledged entities with their clinical consequences. Often, the clinicopathological correlation appears to be strong, significant, and well documented. In other instances, lesions may have a tendency to occur with clinical conditions and in the rest of the cases there is only an anecdotal association. A major problem with the literature related to the placenta is that most of it has been produced based solely on abnormal placentas, so that for many features it is not clear what is pathologically abnormal and what is a normal variant. Basic studies are necessary to analyse normal placentas statistically and to identify the normal variants of histological lesions during the course of pregnancy.

It is also apparent that because function depends on the reserve capacity of the placenta, several findings can be judged only in the clinical context: the importance of a particular lesion depends on its localisation and on the extent of the lesion (the proportion of the placenta involved and the size and the condition of the uninvolved placenta). Some features can be within normal limits in term placentas, whereas earlier in pregnancy they may be pathological. In addition, the assessment of the lesions is even more complex because several pathological conditions can coexist in the same placenta.

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