Examination of the human placenta

B Hargitai, T Marton, P M Cox

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 pathology laboratory. The benefits of examining placentas to identify conditions that can be recurrent or inherited include:

- Identifying and treating maternal conditions such as infection, diabetes, hypertension, and autoimmune disorders.
- Recognising fetal conditions such as congenital anomalies, chromosomal anomalies, and fetal growth restriction.
- Diagnosing placental conditions that may affect future pregnancies, such as placenta accreta, placenta previa, and placental abruption.

Abbreviations: AAA, arterio-arterial anastomosis; AVA, arterio-venous anastomosis; IUGR, intrauterine growth restriction; VVA, veno-venous anastomosis

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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.10 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
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 Bentirschke and Kaufmann13). 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

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### Group 1: full examination

**Group 1A**
- Rhesus isoimmunisation with admission to the NNU
- Any IU anaemia requiring IU transfusion
- Morbidity adherent placenta

**Group 1B**
- Maternal pyrexia
- Prematurity (< 34 weeks and not PET/IUGR)
- Severe fetal Distress, admission to the NNU
- Neonatal infection

**Group 1C**
- IUGR
- Prematurity (< 34 weeks) due to PET/IUGR
- Severe PET
- Abruption

**Group 1D**
- Hydrops
- Fetal anomaly
- Stillbirth

### Group 2: macroscopic examination only and afterwards storage (unfixed, 2 weeks, 4°C, urgent examination on clinical request)

- Abnormal shape
- Single umbilical artery
- Uncomplicated twin pregnancy

### Group 3: storage (unfixed, 2 weeks, 4°C, urgent examination on clinical request)

- PROM
- Prematurity, 34–36 weeks
- Gestational diabetes
- Rhesus negative mother
- Maternal group B streptococcus
- Uncomplicated pre-eclampsia

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Figure 3  Indications to examine the placenta, with examples of the minimum blocks. IU, intrauterine; IUGR, intrauterine growth restriction; NNU, neonatal unit; PET, pre-eclamptic toxaemia; PROM, premature rupture of membranes.
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.

**Figure 4** Worksheet for macroscopic examination. DiDi, dichorionic diamniotic; DiMo, diamniotic monochorionic; MoMo, monochorionic monoamniotic.

| Case number. | Name and age of the mother, Date of birth. |
| Twins | YES/NO |
| Dimensions: | Length: cm Width: cm Thickness: cm |
| Trimmed weight: | gm |
| Placenta shape: | Round Oval Irregular Succenturiate lobes(s) |
| Umbilical cord: | |
| Insertion: | central paracentral eccentric marginal velamentous |
| Length: | cm |
| Average diameter: | cm |
| Number of vessels: | |
| Twists: | under coiled/normal/ hypertwisted |
| True knot: | YES/NO |
| Other abnormality: | |
| Membrane characteristics: | |
| Insertion: | marginal circummarginate circumvallate |
| Colour: | clear semipaque opaque |
| Fetal surface: | |
| Other abnormality: | |
| Maternal surface: | |
| Complete/Incomplete/Ragged | |
| Other abnormality: | clot/crater |
| Cut surfaces: | |
| Focal lesion | YES/NO |
| Size: | % |
| Position: marginal/eccentric/central/multiple |
| Description: | |
| Macroscopically identifiable diffuse lesion: | YES/NO % |

**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 chrorionicity 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 chrorionicity. The dividing membrane in monochorionic pregnancy is thin and translucent (with no
The clinical relevance of placental abnormalities

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Clinicopathological correlation</th>
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<tr>
<td>Umbilical cord</td>
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<td>Short cord (less than 40 cm)</td>
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| Long cord (longer than 70 cm) | High fetal and neonatal mortality rates and increased frequency of neurological abnormality
| Maternal factors: systemic diseases, delivery complications, increased maternal age
| Fetal factors: non-reassuring fetal status, respiratory distress, vertex presentation, cord entanglement, male sex, increased birth weight
| Gross placental features: increased placental weight, overcoiled cord, true knots, congestion, cord prolapse causing fetal distress |
| Marginal cord insertion | IUGR, still birth, neonatal death, premature birth, low birth weight
| Velamentous insertion | Fetal haemorrhage, fetal death, low birth weight, premature birth, maternal smoking, advanced maternal age |
| Overcoiling or undercoiling of the cord | Fetal demise fetal intolerance to labour, IUGR, chorioamnionitis
| True knot | If tight, associated with perinatal mortality of 10% and umbilical vessel thrombosis
| Single umbilical artery | Single umbilical artery is associated with fetal malformation chromosome aberration in 25–50%, with IUGR and increased perinatal mortality in normally formed infants |
| Thrombosis of umbilical cord vessels | Thromboembolic spread to placental or fetal vessels. The consequences of cord vessel thrombosis for the feto may be wide. Severe sequelae such as fetal death, cerebral palsy and IUGR have been described, but delivery at a healthy, live neonate may also occur |
| Umbilical cord vessel vasculitis and funisitis | Umbilical cord vessel vasculitis and funisitis are associated with cord vessel thrombosis, preterm delivery, amniotic infection, vasa previa of cord vessels
| Necrotising funisitis | It is often associated with premature rupture of the membranes, preterm labour, IUGR, intrauterine death. Usually seen with acute chorioamnionitis. Candida, streptococci, herpes, and syphilis are reported to play a role in the pathogenesis of necrotising funisitis. Mostly associated with chorioamnionitis NOG |
| Membranes | |
| Acute chorioamnionitis (including "subchorial intervillous") | Strong association with premature rupture of membranes and preterm delivery. Fetal intrauterine infection may occur. Maternal fever and tachycardia are described, but may be asymptomatic. Recently, chorioamnionitis has been implicated as a risk factor for periventricular leukomalacia and cerebral palsy |
| Chronic chorioamnionitis | Association with premature rupture of membranes, preterm delivery, and prolonged rupture of membranes has been observed. It has been described in herpes virus infection |
| Amnion epithelial vacuolisation | Cell degeneration and necrosis of amniotic epithelial cells can be seen in normal and abnormal pregnancies and the evaluation of these alterations might be fairly uncertain because of artefact effects. Small, lipid containing vacuoles in the cytoplasm are the feature, strongly associated with gastrochisis |
| Pigmented macrophages, meconium staining | The presence of meconium staining is not necessarily associated with adverse fetal outcome. Meconium staining indicates the danger of meconium aspiration and with other histological signs of fetal distress may underline the diagnosis. Vasa previa of cord vessels and fetal chorionic vessels is reported as a consequence of meconium exposure |
| Deciduitis, acute deciduitis, chronic decidual necrosis | Acute deciduitis in the decidua capsularis is often associated with ascending infiltrations of the placental membranes, and may be unimportant in isolation. Severe, necrotising, acute deciduitis can be found in placentas with retroplacental haematomata. Chronic deciduitis with scattered infiltration may represent a physiological condition of maternal lymphocyte response |
| Placenta | |
| Low placental weight, below 10th centile for gestational age | IUGR, pre-eclampsia, increased intervillous fibrin deposition, villitis of unknown origin, and trisomy |
| High placental weight | Maternal diabetes mellitus, maternal or fetal anaemia, fetal hydrops; may also be seen in congenital syphilis, Beckwith-Wiedemann syndrome, congenital nephrotic syndrome |
| Thin placenta (placenta annulare or placenta membranacea) | 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 |
| Placental haemorrhage | |
| Retroplacental haematomata | Large retroplacental haematomas can cause extensive infarction involving a sufficient proportion of the villous tissue to cause fetal hypoxia or lead to perinatal hypoxia or can be seen as a sign of accelerated maturation if the duration of pregnancy was less than 40 weeks |
| Subchorionic haematomata (massive subchorial thrombosis, Bree’s mole) | 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 |
| Placenta praevia | 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 hysterectomy because of excessive bleeding. To make the pathological diagnosis of a placenta accreta, examination of the entire uterus is necessary |
| Placenta accreta, increta, and percreta | |
| Placental choriocarcinoma and intervillous space abnormalities | Increased numbers of syncytiotrophoblast inclusions in: pre-eclampsia, hypertension, diabetes mellitus, maternal anaemia, pregnancy at high altitude, thick section (artefact). A correlation between increased syncytiotrophoblast and fetal hypoxia has not been reported. An excessive increase of syncytiotrophoblast may result from reduced fetal perfusion and placental hypoxia or can be seen as the sign of accelerated maturation if the duration of pregnancy was less than 40 weeks |
| Syncytial knots | |
| Infarct (acute or old) | No clinical relevance if it is single, marginal, and/or involves less than about 5% of the villous tissue |
| Extensive placental infarction | Involving more than 10% of villous tissue: fetal hypoxia, IUGR, stillbirth, pregnancy-induced hypertension, abruptio placentae, neurological abnormalities |
| Nucleated RBC | Raised numbers may occur in many causes of chronic hypoxia, IUGR, stillbirth, acute fetal blood loss, maternal diabetes, and erythroblastosis fetalis |
| Villous basilar membrane thickening | Pre-eclampsia, essential hypertension, diabetes mellitus |
| VSM deficiency | 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 |
| Villous stromal fibrosis and sclerosis | Extensive stromal fibrosis occurs in terminal villous deficiency, in IUGR, and in avascular villi as a result of stem vessel thrombosis, and in CMV infection |
| Villous oedema | 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 hydatidiform moles. It is correlated with neurological impairment and cerebral palsy. May be normal if focal |
| Dysmaturity/immaturation | 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 |

Table 1 – The clinical relevance of placental abnormalities
chorionic layer), whereas that of a dichorionic placenta is thicker, because it contains two chorionic layers between the amniotic sacs. The dividing membrane can be sampled as a membrane roll or in “T” section form. A properly oriented T section is the best sample to prove chorionicity. The dividing membrane may be useful to record the sites of insertion and the number and direction of deep anastomoses (AVA). The anatomical background of chronic twin-to-twin transfusion syndrome seems to be a unidirectional arteriovenous shunt between the donor and the recipient twin. Injection studies can be performed in fresh specimens to clarify the type of the anastomosis. In fixed placenta, arteries may be identified by the fact that they are always superficial to the veins. Arterio-venous anastomosis (AVA) may be identified by the presence of an impaired vessel from one twin feeding an area drained by the co-twin. In monochorionic diamniotic placentas, it may be useful to record the sites of insertion and distance between the cord insertions, the relative size of the placentas, and the number and minimum diameter of superficial anastomoses (AAA/AVV), and the number and direction of deep anastomoses (AVA). The number and direction of deep anastomoses (AVA) are associated with poor outcome. The anatomical background of chronic twin-to-twin transfusion syndrome seems to be a unidirectional arteriovenous shunt between the donor and the recipient twin. Injection studies can be performed in fresh specimens to clarify the type of the anastomosis. In fixed placenta, arteries may be identified by the fact that they are always superficial to the veins. Arterio-venous anastomosis (AVA) may be identified by the presence of an impaired vessel from one twin feeding an area drained by the co-twin. In monochorionic diamniotic placentas, it may be useful to record the sites of insertion and distance between the cord insertions, the relative size of the placentas, and the number and minimum diameter of superficial anastomoses (AAA/AVV), and the number and direction of deep anastomoses (AVA).
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 papyraceous. 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 intention 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 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 whereas earlier in pregnancy they may be pathological. In other instances, lesions may have a tendency to occur in a pathological manner. This correlation appears to be strong, significant, and well documented. In other instances, lesions may have a tendency to occur with increased incidence of structural and chromosomal anomalies and growth restriction. Am J Perinatol 2000;17:229–32. Heilitz SA. Thrombosis of the umbilical cord: analysis of 52 cases and literature review. Pediatr Pathol 1988:8:37–54.

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