Postpartum Haemorrhage

6

6.1 Definition, Incidence and Main Risk Factors

Postpartum haemorrhage occurs more frequently in the first 2 h after delivery and is classified as **early or primary postpartum haemorrhage** (i.e. occurring in the first 24 h after birth). Late or secondary postpartum haemorrhage (appearing after the first 24 h) is outside the aim of this chapter.

There is no worldwide agreement on the definitions of postpartum haemorrhage and major postpartum haemorrhage. Some define **postpartum haemorrhage** as blood loss exceeding 500 ml and **major postpartum haemorrhage** as blood loss exceeding 1000 ml. Others define postpartum haemorrhage as blood loss exceeding 500 ml in vaginal deliveries and exceeding 1000 ml at caesarean section. The limitation of all these definitions is the difficulty in quantifying blood loss accurately, particularly in vaginal deliveries. Collector bags can be used for this purpose, but blood frequently falls outside; amniotic fluid and urine may be collected and both will affect quantification. Weighing of swabs is routinely performed in some centres, but the practice is time-consuming and not widely disseminated, and similar inaccuracies to those referred for collector bags may occur. The most widely used alternative is visual estimation of blood loss, but this has well-known limitations, although improved accuracy may be achieved with visual aids, where the appearance of different blood quantity losses is depicted on photographs/drawings (Fig. 6.1). An additional problem arises from the fact that small women and those with pre-existing anaemia may decompensate with lesser quantities of blood loss.

Another definition of postpartum haemorrhage is a reduction in the haematocrit exceeding 10 %, but routine blood analysis before and after birth is rarely practised in low-risk labours, where the majority of complications occur. The need for blood transfusion is an alternative criterion, but it is used mainly in research settings, it leaves out less severe cases of haemorrhage, and transfusion criteria may vary between centres.

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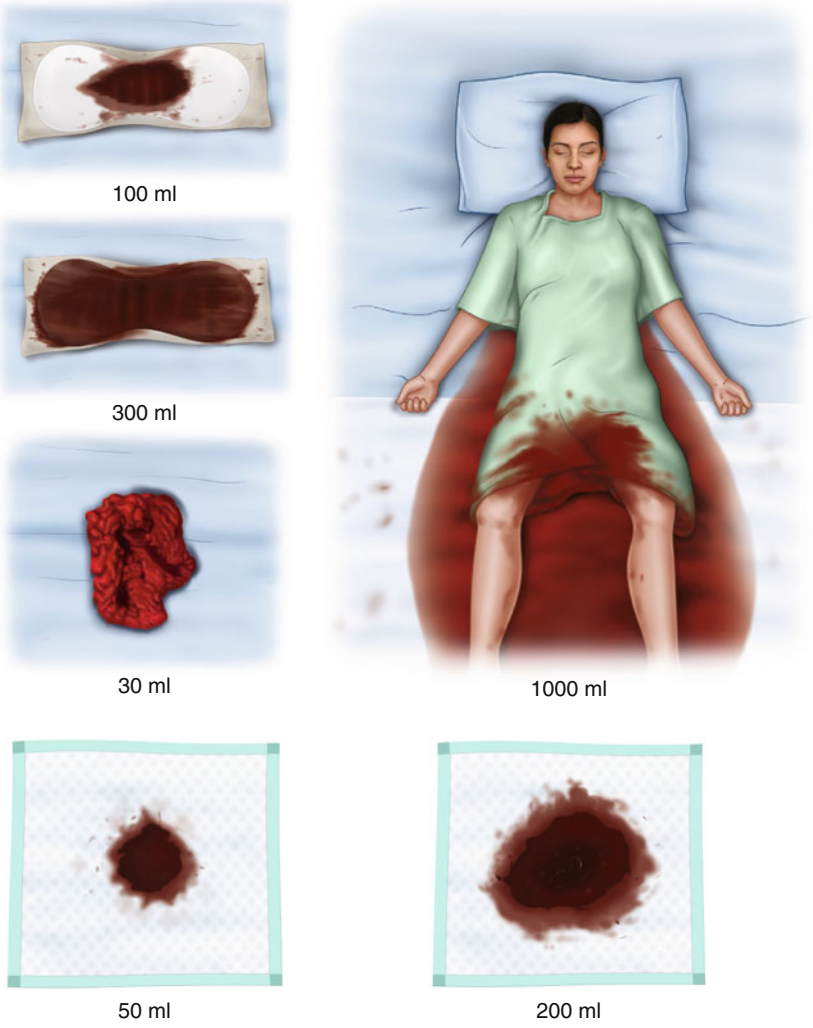

Fig. 6.1 Quantification of blood loss based on drawings

From a clinical point of view, the most important factor to define **postpartum haemorrhage** is the one that should trigger a response from the healthcare team. In the majority of situations, this occurs because **profuse and/or persistent genital bleeding** is witnessed to occur spontaneously after birth or when uterine massage is performed. Bleeding may be mild and rapidly reversible, so it is important to separate the concept of **major postpartum haemorrhage**, where more complex interventions need to be considered. **Blood loss exceeding 1000 ml** or a **heart rate approaching the systolic blood pressure** is probably the most useful criteria, from a clinical point of view. The "shock index", defined as the heart rate divided by systolic blood pressure, is used in other areas of Medicine and has recently been applied to postpartum haemorrhage. It is considered abnormal when exceeding 0.9.

The three major causes of early postpartum haemorrhage are **uterine atony**, which is responsible for about 70–80 % of cases, **genital tract lesions** accounting for 10–15 % of cases and **retained placental tissue**. Partial placental retention is usually associated with recurring uterine atony and haemorrhage. **Abnormally adherent placenta** (accreta, increta and percreta) is normally associated with haemorrhage when attempts are made to remove the placenta, and its incidence has been increasing in some parts of the world because of escalating caesarean section rates. Rarer causes of postpartum haemorrhage are **uterine inversion**, **uterine rupture** and **maternal bleeding disorders**. Uterine inversion is thought to be caused mainly by mismanagement of the third stage of labour, namely by excessive pressure on the uterine fundus, premature traction on the umbilical cord or excess traction during manual removal of an abnormally adherent placenta. Less frequently it occurs after an episode of coughing or vomiting during the third stage of labour.

The incidence of early postpartum haemorrhage varies widely, depending on the criteria used for the diagnosis, the population studied and the methods used for prevention, but it is reported to occur in 2–10 % of all deliveries. The most important risk factors are listed in Table 6.1, but many cases occur in women where these are not present.

Table 6.1 Risk factors for postpartum haemorrhage

High parity
High uterine volume – multiple pregnancy, macrosomia, polyhydramnios
Caesarean delivery and instrumental vaginal delivery
Prolonged or precipitate labour
Labour induction and acceleration
Placental abruption
Uterine leiomyomas and malformations
Maternal bleeding disorders
Corioamnionitis
Placenta praevia and abnormally adherent placenta
Pre-eclampsia
Amniotic fluid embolism
Previous postpartum haemorrhage

6.2 Consequences

Postpartum haemorrhage remains an important cause of **maternal mortality**, in both low- and high-resource countries. In European countries, maternal deaths due to postpartum haemorrhage occur in about 0.003 % of all births, and this incidence has not changed significantly over the last 30 years.

Less is known about **maternal morbidity** associated with postpartum haemorrhage, but most of it is related to the side effects of treatment. Some surgical procedures are associated with loss of fertility (conservative treatments and hysterectomy), infectious morbidity, urologic lesion and intensive care unit stay. Other complications are associated with allergic reactions to medication, colloids and blood replacement products. Birth canal lacerations may also occur as a consequence of mechanical treatments, but these seldom have long-term consequences. Decreased perfusion of the pituitary gland for prolonged periods of time has been associated with secondary panhypopituitarism (Sheehan's syndrome), but this complication is currently very rare in high-resource countries.

6.3 Diagnosis

Postpartum haemorrhage can be defined as **profuse and/or persistent genital bleeding** occurring spontaneously after birth or when uterine massage is performed. The diagnosis may be triggered by routine clinical re-evaluation, maternal complaints of dizziness and loss of vision, maternal paleness or by the detection of tachycardia or hypotension. The main clinical usefulness of this definition is that it constitutes a trigger for action from the healthcare team.

The diagnosis of **major postpartum haemorrhage** implies the same findings, but in addition **blood loss exceeds 1000 ml** (by quantification or visual estimation) or **maternal heart rate approaches systolic blood pressure** (the shock index exceeds 0.9).

6.4 Clinical Management

Management of postpartum haemorrhage involves two major components – support of maternal circulation/oxygenation and treatment of the underlying cause. When an anaesthetist and an obstetrician are present in the room, the responsibility for these two aspects is usually divided among them. In the remaining situations, the person in charge needs to take care of both.

6.4.1 Anticipating the Situation

When the risk factors listed in Table 6.1 are identified, increased surveillance usually allows earlier diagnosis and intervention. Continuous monitoring of maternal

pulse and blood pressure should be considered in the first stages of any abnormal genital bleeding, in addition to frequent re-evaluation of haemorrhage and uterine contracture.

6.4.2 Clearly Verbalising the Diagnosis

It is important that the whole team of healthcare professionals is aware of the diagnosis of postpartum haemorrhage, so that they can act accordingly, and therefore this needs to be clearly verbalised, without unnecessarily alarming the labouring woman and her companion.

6.4.3 Asking for Help

One of the first measures should be to summon urgently **at least two midwives**, a **senior obstetrician** and an **anaesthetist**. As stated above, the presence of an anaesthetist guarantees a safer management of basic circulatory and respiratory functions, as well as fluid balance. Care is however needed to maintain good communication between both sides at all times, so that there is coordinated management of the situation.

6.4.4 Initial Evaluation of the Cause of Haemorrhage

A quick evaluation needs to be carried out to establish the most likely cause of haemorrhage. This involves assessment of uterine contracture to diagnose uterine atony, a speculum evaluation to detect lacerations of the birth canal and a re-evaluation of the placenta to establish whether it is complete (no missing cotyledons on the maternal side, no lacerated vessels on the placental margin on the fetal side). Abnormally adherent placenta is usually diagnosed when placental extraction fails, and uterine inversion is diagnosed by bimanual examination. The rarer causes of uterine rupture and maternal bleeding disorders are usually considered only after the initial measures for treatment of postpartum haemorrhage have failed.

6.4.5 Support of Maternal Circulation and Oxygenation

6.4.5.1 Venous Catheterisation and Blood Volume Replacement

One of the first measures should be to guarantee adequate access for fluid perfusion, by **catheterising a vein with a large bore catheter** (14G or 16G). If major postpartum haemorrhage is identified, a second vein should be catheterised and at the same time blood collected for full blood count, coagulation studies and cross-matching. **Fluid replacement with crystalloids** (saline, Ringer's lactate) at high perfusion speeds should follow, avoiding dextrose solutions as they may worsen acidosis.

About three litres of crystalloids are required to replace one litre of blood loss, because of loss to the extravascular space. In previously healthy women, a 1.5 l blood loss can usually be compensated just with the use of crystalloids. With further loss, replacement with colloids and blood products needs to be considered (see below).

6.4.5.2 Maternal Monitoring

Continuous monitoring of maternal **heart rate** and **oxygen saturation** should be started promptly and **blood pressure** measured every 5–10 min. Consideration should also be given to **electrocardiographic monitoring**, particularly with major postpartum haemorrhage or when there is loss of consciousness.

6.4.5.3 Bladder Catheterisation and Measurement of Urinary Output

Bladder catheterisation is needed to measure urinary output, which should be kept above 30 ml/h, and to allow more effective external uterine massage (see below).

6.4.5.4 Maintain Maternal Oxygen Supply to the Brain

It is important to guarantee adequate oxygen supply to the brain, and for this the woman should be placed in a slight **head-down position** or alternatively her legs raised to increase venous return. **Oxygen** should be administered by face mask, starting at 30 %, 10–15 l/min, and thereafter adapting according to oxygen saturation levels.

6.4.5.5 Decision to Start Colloids

When blood loss exceeds 1.5 l or there is difficulty in maintaining normal maternal blood pressure with crystalloids, administration of colloids needs to be considered. The latter includes albumin, dextran, gelatin and hydroxyethylamide. These substances assure a higher intravascular volume and some improve oxygen transport in the microcirculation, but they all carry a small risk of anaphylaxis. The frequency of severe reactions (shock, cardiorespiratory arrest) is 0.003 % for albumin, 0.008 % for dextran, 0.038 % for gelatin and 0.006 % for hydroxyethylamide. Colloid volumes exceeding 1000–1500 ml per day may also affect coagulation tests.

6.4.5.6 Decision to Administer Blood Products

Administration of blood products should be considered when haemorrhage persists and is approaching 2000 ml. It is usually also considered when there is prolonged haemodynamic instability or a low haemoglobin count. The main objective is to recover oxygen transport capacity, but there are also haemodynamic and clotting benefits. In a shared decision with the hospital blood bank, 2–4 units of packed red blood cells may be transfused initially. All obstetric units must have access to blood from universal donors (O negative blood) in less than 30 min, but usually there is time for cross-matching and individualised transfusion. There is currently no consensus on the ideal balance between transfusion of packed red cells and fresh frozen plasma, but it is prudent to administer at least one unit of fresh frozen plasma for each 4 units of packed red cells, in order to prevent consumption coagulopathy.

Additional blood transfusions, including cryoprecipitate, platelets and recombinant factor VIIa, are usually decided in coordination with the hospital blood bank, and serial evaluations of haemoglobin and coagulation tests are required to guide decisions.

6.4.5.7 Maintain Body Temperature

In hypovolemic shock, low body temperature will contribute to peripheral hypoperfusion and tissue damage. This can be reduced by maintaining normal body temperature and by administering previously warmed fluids.

6.4.6 Treatment of Uterine Atony

6.4.6.1 Initial Measures

The finding of a non-contracted uterus after placental delivery should lead to immediate **external uterine massage** in order to stimulate contraction. Previous **catheterisation of the bladder** facilitates this procedure and also allows measurement of urine output (see above).

6.4.6.2 Medical Treatment

The options available for medical treatment of uterine atony are displayed in Table 6.2. Regardless of whether or not it has been previously used for the prevention of postpartum haemorrhage, **oxytocin** should be the first-line treatment for uterine atony. It is preferably administered intravenously in rapid infusion, but can also be given by slow 10 IU intravenous bolus, although the latter has been associated with rare cases of severe maternal hypotension. If the intravenous route is not available, successful treatment of uterine atony with intramyometrial administration of 10 IU oxytocin has been reported in a small number of cases, by transcervical injection at 2 and 10 o'clock.

Uterine massage, bladder catheterisation and intravenous oxytocin resolve the majority of cases of uterine atony. There is little scientific evidence on which to base the order of subsequent treatments, so it depends mostly on local experience. **Rectal misoprostol** appears to be effective and safe, having as contraindications inflammatory bowel disease and a history of previous allergy to the drug. Transient hyperthermia may occur, but no measures are usually required to treat it. **Other**

Table 6.2 Uterotonic agents used for the medical treatment of uterine atony

Oxytocin 20 IU in 500 ml of saline, in IV perfusion at 250 ml/h
Prostaglandins:
Misoprostol 800–1000 μg rectal
Sulprostone 1 mg in 500 ml of saline, in IV perfusion at 125 ml/h, which can be increased up to 500 ml/h. After contracture, it is reduced to the initial dose
Carboprost (15-methyl prostaglandin F2 alpha) 0.25 mg IM, repeated every 15 min for a maximum of 8 doses

prostaglandins are available in some countries and have asthma, cardiac disease, hypertension and diabetes as contraindications.

6.4.6.3 Mechanical Treatments

Bimanual uterine compression is a simple procedure that generally controls bleeding from uterine atony and other intrauterine causes (Fig. 6.2). A hand is placed on the abdomen over the uterine fundus, and the contralateral one is inserted in the vagina to compress the cervix and uterus against the abdominal hand. Pressure should be sustained to collapse bleeding vessels and to promote coagulation in the placental bed. The procedure may not be applicable in some women, if it causes unreasonable pain or discomfort. The main difficulty resides in the executor's capacity to maintain sustained pressure for long periods of time, so frequent substitution may be required. It may also be used as a temporary measure to control bleeding, while other treatments are being considered or prepared.

Uterine balloon tamponade has gained popularity in the last decades and can be performed with devices especially developed for postpartum haemorrhage, the Bakri (Fig. 6.3) and Ebb balloons, or those adapted from other settings, the gastric part of the Sengstaken-Blakemore balloon (developed for oesophageal haemorrhage), the Rusch balloon (developed for bladder haemorrhage) or a condom adapted to a Foley catheter. The balloon is introduced through the cervix with a guiding hand, or using a speculum and sponge forceps, and filled with saline (ideally warmed up to 37 °C) until it is felt or seen to slightly dilate the cervix. The amount of fluid varies according to uterine dimensions, but is usually around 300–500 ml. Prophylactic antibiotics should be started and the balloon removed 12–24 h later. The reported success rate with this technique is around 85–90 %.

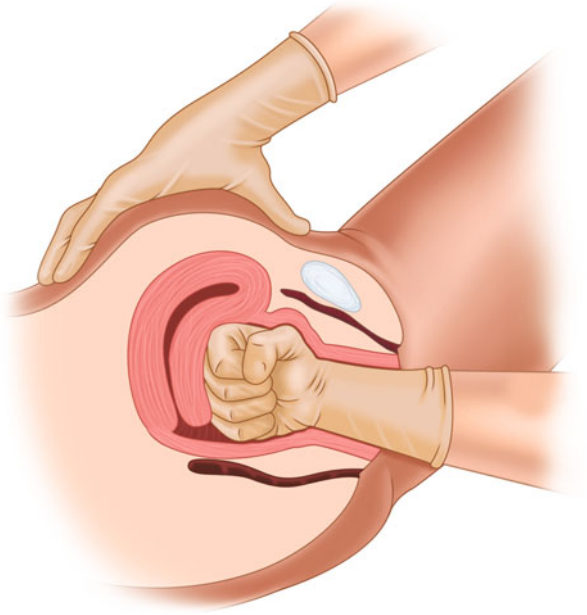

Fig. 6.2 Bimanual uterine compression

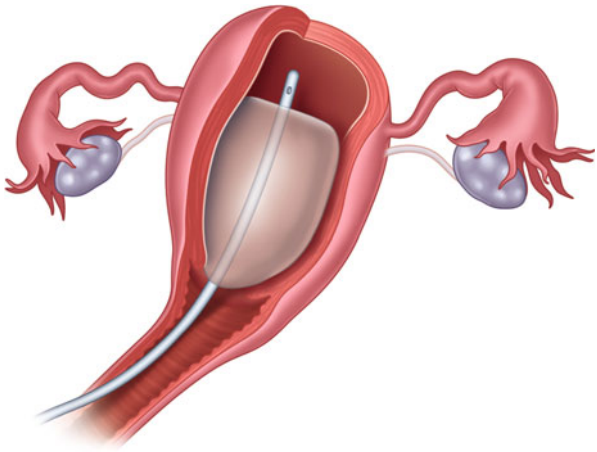

Fig. 6.3 Uterine tamponade with the Bakri balloon

In centres where there is an experienced intervention radiologist, **uterine artery embolisation** is another option. Angiography may be used to identify the bleeding vessels and to define the best strategy for embolisation. A catheter is then introduced into the femoral artery under local anaesthesia and inserted under fluoroscopic control until the tip lies at the root of the contralateral uterine artery. Embolisation may be performed with gelatin sponge pledgets, microspheres of polyvinyl alcohol or tri-acryl gelatin microspheres, all of which are absorbed in about 10 days. The complication rate depends on local experience, but is reported in about 5 % of cases. It includes fever, deep vein thrombosis, pancreatitis, infection, uterine necrosis, vascular perforation and femoral artery occlusion. Several observational studies report success rates of 90–95 % and cases of viable subsequent pregnancies.

In low-resource settings, **antishock garments** and **aortic pressure** may be used as temporary measures to reduce bleeding and the resulting haemodynamic instability, allowing patient transfer or the consideration of other treatments. Aortic pressure is performed by placing a hand in the midline above the uterus and exerting continuous downward pressure with the heel of the hand. These measures are seldom required in high-resource countries.

6.4.6.4 Surgical Treatments

When bleeding does not stop with the medical and/or mechanical methods described above, consideration must be given to moving the patient to the operating theatre and preparing for laparotomy.

Several **compression sutures** have been described, and they are most successful when intraoperative manual uterine compression results in cessation of bleeding. The **B-Lynch** suture (Fig. 6.4, left) is perhaps the most widely used, with a reported success rate of around 90 %. A pair of absorbable sutures is symmetrically placed on either side of the midline, but a second pair may be needed in large uteri. The B-Lynch suture was originally described for cases where there was a caesarean incision, and a modification described by **Hayman** may be used when the uterus is

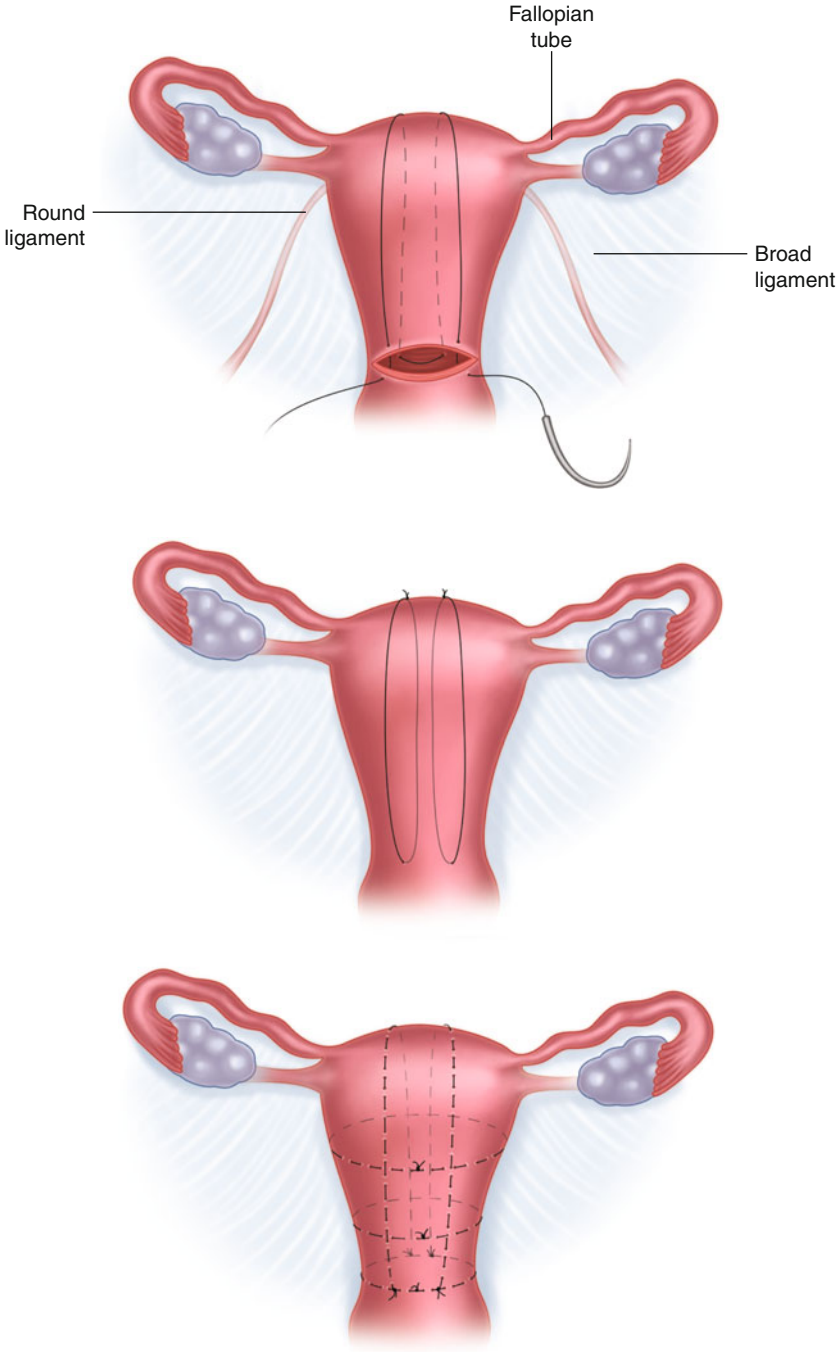

Fig. 6.4 The B-Lynch (*top*), the Hayman (*middle*) and the Pereira sutures (*bottom*)

intact (Fig. 6.4, centre). In addition to B-Lynch and Hayman sutures, transverse uterine **Pereira** sutures may be employed for increased compression, if necessary (Fig. 6.4, right).

For situations of continuous uterine bleeding from the lower uterine segment due to placenta praevia, **transfixing vertical sutures** are frequently successful in haemorrhage control (Fig. 6.5).

An alternative approach is **progressive uterine devascularisation**, involving a stepwise ligation of the ascending branch of one of the uterine arteries, followed by the contralateral one, the uterine branch of one of the ovarian arteries and the contralateral branch (Fig. 6.6). The sequence stops as soon as haemorrhage is controlled. For uterine artery ligation, the bladder is reflected downwards, a small opening is created in the broad ligament 2 cm below the level of a caesarean incision, and the needle is passed to transfix the myometrium about 2 cm from the lateral margin. Success rates are reported to be around 85 %, and the technique is easier to execute than internal iliac (hypogastric) artery ligation. Uterine blood flow is maintained through anastomoses from the vesical and rectal arteries, and there is subsequent recanalisation of the uterine arteries. Cases of subsequent pregnancy have been reported.

Internal iliac (**hypogastric**) **artery ligation** has lost popularity over the last decades, as it requires the presence of a surgeon with experience in retroperitoneal dissection. Because of major collateral anastomoses present in the pelvis, the reported success rate is only 40-70 %, and it is also associated with important maternal morbidity.

Peripartum hysterectomy is one of the last resorts in treatment of postpartum haemorrhage, and it should be considered when the patient does not desire future pregnancies and consents to the proposal or as a life-saving procedure when this situation is protected by law. Surgical technique is similar to that of hysterectomy performed for gynaecological reasons, but the pedicles are usually more thick, oedematous and vascular, so double clamping and ligation are usually preferable. Identifying the cervix may be difficult in these situations, and it is useful to insert a

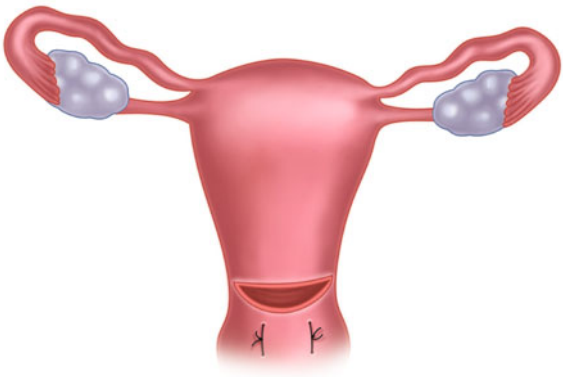

Fig. 6.5 Transfixing vertical sutures, used for bleeding from the lower uterine segment

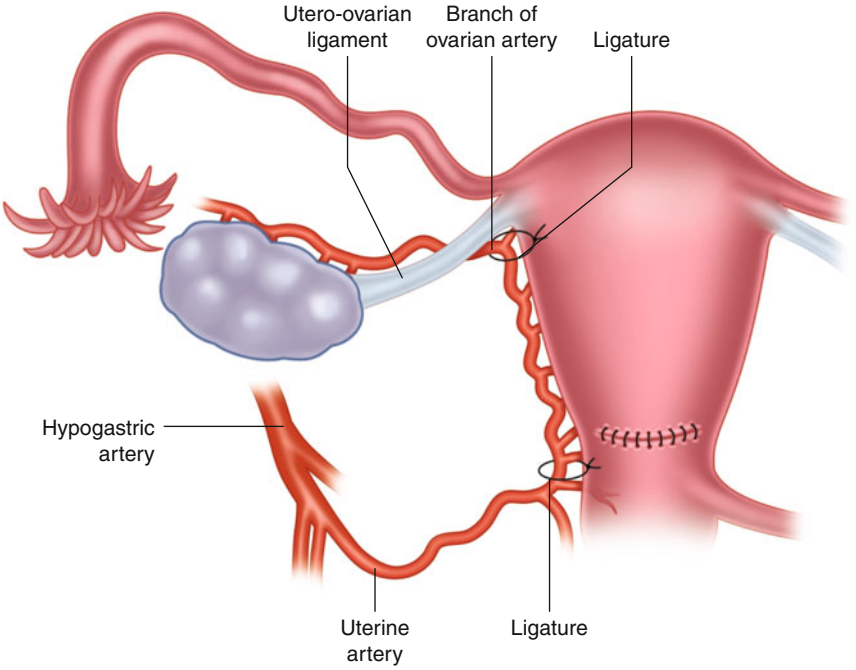

Fig. 6.6 Progressive uterine devascularisation

finger through the cervix into the vagina and hook it up to isolate the cervical rim. This will also guide the vaginal incision for total hysterectomy. Subtotal hysterectomy is usually easier to perform and is associated with less ureteral lesions. Recent studies report low mortality with the procedure, but morbidity and prolonged intensive care unit stay are frequent.

6.4.6.5 Pelvic Tamponade

When pelvic vessels continue to bleed after hysterectomy, pelvic tamponade with gauze inserted into a sterilised plastic bag and connected to a weight via the vaginal opening has been reported in a small number of cases (Fig. 6.7). Prophylactic antibiotics are started, and the bag is opened 24 h later to extract the gauze pads one by one, after which the bag is removed.

6.4.7 Treatment of Birth Canal Injuries

Birth canal injuries may be detected on the initial speculum examination or may need to be carefully searched in a later re-evaluation, motivated by persistent haemorrhage with the uterus firmly contracted. Adequate light, positioning and analgesia are required for this, together with vaginal retractors and a systematic approach to evaluate the cervix and vagina. Two ring forceps are usually used to explore the cervix, moving them alternatively to visualise the whole

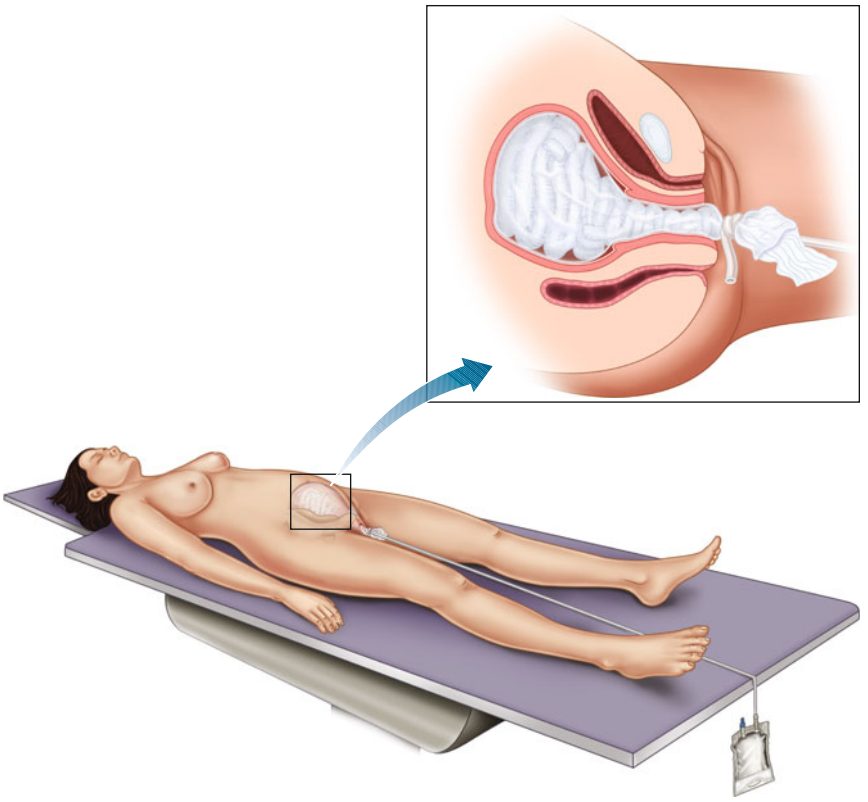

Fig. 6.7 Pelvic tamponade

circumference. Only **cervical lacerations** measuring more than 2–3 cm and those that are actively bleeding need to be repaired, using continuous absorbable suture and starting at the apex.

Vaginal wall lacerations should be visualised in their entire extension and corrected with a continuous absorbable suture. Any gushing arterial haemorrhage should be clamped and ligated individually. Subsequent vaginal packing with large swabs may be necessary to control minor bleeding, and when this occurs it is preferable to catheterise the bladder to avoid urinary retention. When located high in the vagina, lacerations may extend to the uterus and be associated with haematomas of the broad ligament and/or retroperitoneal space (see below).

Birth canal haematomas may be located in the vulva, vagina, broad ligament, ischial-rectal or retroperitoneal spaces and may form over the course of minutes or hours. They may occur in isolation or associated with vaginal lacerations and are caused by a vessel bleeding into a newly formed space. Small and non-expanding haematomas should be managed conservatively, with frequent re-evaluations of size and accompanying symptoms. Large or expanding haematomas require surgical drainage under anaesthesia. After removal of the blood and clots, bleeding vessels should be searched and ligated individually. If there is continued oozing, the space

should be closed. Broad ligament and retroperitoneal haematomas can be diagnosed by ultrasound, computer tomography or magnetic resonance imaging. They are preferably treated conservatively, unless there is haemodynamic instability, infection or rapid expansion. Selective arterial embolisation by an intervention radiologist is currently the preferential method of treatment. Surgical treatment of retroperitoneal haematomas requires a surgeon with experience in the exploration of this space.

6.4.8 Treatment of Placental Retention

6.4.8.1 Complete Placental Retention

Complete retention of the placenta associated with haemorrhage requires prompt manual removal of the placenta under regional or general anaesthesia and subsequent uterine curettage if any fragments remain attached. This is followed by external uterine massage, prophylactic antibiotics and intravenous perfusion of uterotonic agents (Table 6.2) for at least 2 h. If a cleavage plane between the uterine wall and the placenta is not identified, this establishes the diagnosis of abnormally adherent placenta increta or percreta (see below), and when bleeding cannot be controlled with the medical and mechanical methods described above, immediate laparotomy should be undertaken.

6.4.8.2 Partial Placental Retention

A poorly contracted uterus or recurrent episodes of uterine atony should lead to the suspicion of partial placental retention. Re-evaluation of the placenta will usually help to establish the diagnosis, but transabdominal ultrasound is required to confirm it. Uterine curettage should be performed to remove the remaining placental fragments, under regional or general anaesthesia.

6.4.9 Treatment of Rare Causes of Postpartum Haemorrhage

6.4.9.1 Uterine Inversion

Uterine inversion is a very rare but potentially life-threatening situation. It can be diagnosed by vaginal examination, with the inverted uterine fundus found in the uterine cavity (partial inversion), in the vagina (complete inversion) or even in the exterior. The placenta may still be attached to the uterus, and in these situations bleeding may be less intense. Sudden hypotension, pallor and bradycardia occur frequently with uterine inversion, caused by neurogenic shock due to traction on the uterine ligaments. Profuse haemorrhage and hypovolemic shock usually follow. **Manual replacement** should be immediately attempted, before the cervix causes congestion of the inverted fundus, making the procedure increasingly difficult. Continuous pressure is applied around the inverted fundus to push it up through the cervical ring, and this may require 2–3 min. If unsuccessful, medications should be administered for **uterine relaxation** (Table 6.3) and the manoeuvre reattempted. A further reattempt can be made in the operating theatre under general anaesthesia

Table 6.3 Uterine relaxants

Nitroglycerine in slow intravenous bolus (50–100 µg IV slowly)
1 vial of 5 ml (5 mg/ml) in 500 ml of saline. Slow intravenous injection of 1–2 ml (50–100 µg) with continuous monitoring of blood pressure
Salbutamol in intravenous perfusion (125 µg at 25 µ/min)
1 vial of 1 ml (0.5 mg/ml) in 100 ml of saline in intravenous perfusion pump at 300 ml/h during 5 min

with halogenated agents. If the placenta remains attached to the uterine fundus, no efforts should be made to remove it at this stage. Manual removal can be attempted after the uterine fundus is replaced.

Unless reversal is quickly obtained, a prompt decision to undergo **laparotomy** under general anaesthesia with halogenated agents should be taken. Manual repositioning can then be reattempted, but if the cervical constriction ring is too rigid, a posterior vertical incision on this ring usually allows passage of the uterine fundus, after which the incision is closed. After repositioning the uterus, prolonged uterine contracture should be stimulated with an uterotonic agent (Table 6.2).

6.4.9.2 Uterine Rupture

This diagnosis should be considered when bleeding persists in spite of medical and mechanical treatments of uterine atony, particularly when there is a history of previous caesarean section or other surgery involving the myometrium. Digital exploration of the uterine cavity via the vaginal route may identify the wall defect, but the diagnosis is usually only established at laparotomy. Surgical management of uterine rupture is considered in Sect. 2.4.5.

6.4.9.3 Abnormally Adherent Placenta

Management of abnormally adherent placenta when it is diagnosed before labour allows planning of delivery and is beyond the aim of this book. This section refers to the acute management of undiagnosed abnormally adherent placenta at the time of caesarean section or during the third stage of labour. Because these situations are relatively rare, there is little scientific evidence on which to base decisions. Two different clinical situations may be encountered. The first is the suspicion of deep myometrial, peritoneal or adjacent organ invasion at the time of caesarean section, before the uterus is incised. In these cases, confirmation of placental location should be made by intraoperative ultrasound, and the uterine incision needs to avoid the placental bed. After the fetus is delivered, no attempt should be made to extract the placenta. If haemorrhage is minimal and the haemodynamic condition is stable, several approaches may be taken, depending on the patient's desire for future fertility. For patients desiring more children or when these desires are unknown (i.e. patients under general anaesthesia), **partial resection of the uterine wall *en bloc* with the placenta** may be attempted if subsequent closure is judged to be anatomically possible. The alternative is to **leave the placenta *in situ***, ligate the umbilical cord with an absorbable suture close to the placenta and close the uterus in an attempt of expectant management. This option is associated with important

haemorrhagic and infectious morbidity, as well as prolonged surveillance, but with careful follow-up has a very low mortality. For patients who do not desire to remain fertile, **peripartum hysterectomy** may be an option when important adjacent organs are not involved in placental invasion. When there is important involvement of adjacent organs or when the expertise for a peripartum hysterectomy is not available, it is preferable to leave the placenta **in situ** and attempt expectant management, even if this results in hysterectomy at a later date. With heavy bleeding and/or a haemodynamically unstable patient, the surgical alternatives described above need to be decided quickly. It is well to remember that definite treatment can be deferred to a later time, and haemorrhage control is the main priority in these situations. Uterine and vaginal packing with gauze, balloon tamponade, B-Lynch sutures, Hayman sutures, uterine and internal iliac artery ligation have all been reported to be successful in a small number of cases. Haemostatic sutures of the placental bed may also be successful in limited areas.

6.4.9.4 Maternal Bleeding Disorders

Several maternal bleeding disorders may be responsible for or may aggravate other causes of postpartum haemorrhage. The detailed description of these conditions is beyond the aims of this chapter, but they are usually managed in collaboration with a haematologist and the hospital blood bank.

6.4.10 Postpartum Haemorrhage at Caesarean Section

Postpartum haemorrhage is more frequent at caesarean section, and it is also easier to quantify blood loss in these situations. Uterine atony remains the most frequent cause, and treatment is not substantially different to that used in vaginal deliveries, involving similar support of maternal circulation/oxygenation and uterotonic agents as first-line treatment (Table 6.2). However, because there is direct access to the uterus, some procedures need to be adapted. Localised uterine atony may benefit from intramyometrial injection of oxytocin, sulprostone and/or carboprost. Bimanual uterine compression is substituted by internal uterine compression, and balloon tamponade can still be performed, but the balloon is usually introduced transabdominally. Compression sutures (Fig. 6.4) are used more frequently, because of ease of access, and they can be combined with balloon tamponade, a procedure that some refer to as the "sandwich technique". Uterine embolisation is seldom employed, because the required equipment is usually unavailable in an operating theatre. Birth canal injuries should still be considered as a possible cause of haemorrhage, particularly when caesarean section was performed during the second stage of labour and/or when there was a difficult fetal extraction.

6.5 Clinical Records and Litigation Issues

It is important to document the names of the healthcare professionals who were summoned, when they were called and when they arrived, which medication and manoeuvres were performed and when and by whom. Inadequate documentation

may cause problems when there is medicolegal litigation, and it is therefore helpful to use a structured pro forma for accurate record keeping.

A frank explanation of the situation to the patient and her closest family by an experienced member of the team is also required at the earliest available opportunity.

MANAGEMENT OF POSTPARTUM HEMORRHAGE DUE TO ATONY

Anticipate the situation	Increase hemorrhage evaluation, monitor HR+BP	☐
Clearly verbalise the diagnosis		☐
Ask for help	Two midwives, senior obstetrician, anesthetist	☐
PPH diagnosed	Rapid evaluation of the cause	☐
	External uterine massage	☐
	Catheterise vein with 14-16G and start crystalloids	☐
	Monitoring - BP, HR, O_2 sat, ECG, consciousness	☐
	Oxygen by mask at 30%, 10-15 l/min	☐
	Head down position/elevation of the legs	☐
	Catheterise bladder and measure urine output	☐
	Oxytocin IV in treatment dose	☐
Major PPH diagnosed	Catheterise second vein with 14-16G	☐
	Bimanual uterine compression	☐
	Blood analysis for Hg, coagulation, cross-matching	☐
	Re-evaluate cause	☐
	Rectal misoprostol	☐
	Consider sulprostone or carboprost	☐
	Consider colloids	☐
	Consider blood products - contact hematologist	☐
	Maintain body temperature	☐
	Consider balloon tamponade	☐
	Consider uterine artery embolization (if available)	☐
Decide surgery	Call operating theatre and transfer	☐
	Compression sutures (B-Lynch, Hayman, Pereira)	☐
	Progressive uterine devascularisation	☐
	Consider internal iliac artery ligation	☐
	Consider peripartum hysterectomy	☐
Clinical records	People called, at what time, and when they arrived	☐
	Decisions taken, when and by whom	☐
	Procedures performed, when and by whom	☐

Suggested Reading

Abdel-Aleem H, Hofmeyr GJ, El-Sonoosy E (2006) Uterine massage and postpartum blood loss. Int J Gynecol Obstet 93:238–239

B-Lynch C, Keith L, Lalonde A, Karoshi M (eds) (2006) A textbook of postpartum hemorrhage, 1st edn. Sapiens Publishing, Duncow

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Ramanathana G, Arulkumaran S (2006) Postpartum hemorrhage. Curr Obstet Gynaecol 16:6–13

Royal College of Obstetricians and Gynaecologists (2009) Prevention and management of postpartum hemorrhage (green-top guideline no. 52). RCOG Press, London

Royal College of Obstetricians and Gynaecologists (2011) Placenta praevia, placenta praevia accrete and vasa praevia: diagnosis and management (green-top guideline no. 27). RCOG Press, London