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Scope of Blood Transfusion in Obstetrics

Subhayu Bandyopadhyay
Ninewells Hospital, Dundee,
 UK

1. Introduction

Obstetrics is one of the major areas in medicine requiring blood transfusion. In the UK about 4000 cases of severe obstetric haemorrhage take place each year, of which most of the patients need blood transfusion (RCOG Green top guideline no. 47). On one hand maternal morbidity and even mortality depends on availability of blood and blood products and on the other hand injudicious use of blood and blood products can cause infection, allergic reaction or antibody production in the mother which can have major impact on the present or future pregnancies (Blood transfusion in obstetrics, RCOG Green top guideline no. 47). The most common complication of blood transfusion is error in transfusion. In the UK, SHOT (Serious Hazard Of Transfusion) is informed about all the complications of transfusion. The largest category of untoward incidents reported to SHOT is 'incorrect blood component transfused' (71%) and the incidence is on the rise (SHOT in Obstetrics: 2005 Annual Report). In this chapter we will discuss the main indication for blood transfusion in obstetric practice in developed world and the ways to prevent blood transfusion.

In modern day obstetric practice, the complications of blood transfusion is well-recognised and in many hospitals in the UK, protocols are in place to boost pre-delivery haemoglobin, so that blood transfusion can be avoided in case of postpartum haemorrhage. If the mother has low haemoglobin in the antenatal period then oral iron supplement (Ferrous Sulphate or Ferrous Fumerate) should be given. Intravenous iron is indicated when there is poor tolerance to oral iron or a quick response is needed. There are two main preparations: iron-dextran and iron sucrose. There is evidence that intravenous iron therapy replenishes iron stores faster and more efficiently than oral iron therapy (Singh et al 1998). Recombinant human erythropoietin is used when anaemia is caused by renal disease. It is safe to use in pregnancy and there is no reported cases of teratogenicity (Braga et al 1996).

There are two main indications for blood transfusion in obstetrics: Ante Partum Hemorrhage (APH) and Post Partum Hemorrhage (PPH). The other important and common indication for blood transfusion in pregnancy is ectopic pregnancy, which like miscarriage may be considered as a gynaecological cause in most units. In the developing world obstetric haemorrhage is the most important cause for maternal morbidity and sometimes mortality (Saving Mothers' Lives: CEMACH Report 2003-2005). In view of all the complications of the blood transfusion, it is only prudent to use blood and blood products with caution and when appropriate. All the other pharmacological agents should be used first. The newer techniques of management of PPH (Intrauterine balloon, use of cell salvage and recombinant factor seven) have revolutionised management of PPH in developed world.

Anaemia in pregnancy: It is hard to determine the prevalence of anaemia in pregnancy in both developing and developed world due to the difference in definition of anaemia worldwide. In the developing world it is found in most severe form whereas in the developed world it is mild. In a comprehensive report on prevalence of anaemia worldwide by WHO (WHO Global Database on Anaemia), the prevalence of anaemia in Afghanistan was highest (61%). In the developed world prevalence of severe anaemia is uncommon (USA 5.7 % of pregnant women and UK 15.2%) .However, in the developed world it is seldom an indication for blood transfusion by itself, when there is no ongoing bleeding or haematological disorder has not been incriminated as the cause for the anaemia.

2. Early pregnancy complications

There are two main types of early pregnancy complications may need blood transfusion - Miscarriage and ectopic pregnancy.

There are different types of miscarriages:

- a. Threatened miscarriage
- b. Incomplete miscarriage
- c. Complete miscarriage
- d. Inevitable miscarriage
- e. Missed miscarriage

Patients classically presents with heavy vaginal bleeding and cramp like lower abdominal pain in most of the types. Missed Miscarriage may remain asymptomatic and sometimes an incidental finding during routine ultrasound examination. Speculum examination may reveal open cervical os in case of incomplete and inevitable miscarriage. Bleeding can be heavy and sometimes clinically underestimated. Careful assessment of bleeding and timely decision of operative management can prevent unnecessary blood transfusion and prolonged hospital stay.

2.1 Ectopic pregnancy

Ectopic pregnancy is defined as implantation of blastocyst at a site other than uterine cavity. It may develop in the fallopian tube (most common), ovaries or even peritoneum.

The main complication of ectopic pregnancy is rupture and if prompt medical attention is not given, it can even be fatal due to intraperitoneal bleeding from the ruptured fallopian tube. It is a common and important cause of maternal morbidity and mortality worldwide, especially in developing countries, where prompt medical care and facilities for blood transfusion is not available. Even in developed countries like UK, the morbidity and mortality can be high. There were 13 maternal deaths deaths from ruptured ectopic pregnancy in 1997-1999 (CEMACH report 2001)

2.1.1 Risk factors for ectopic pregnancy

Idiopathic

Salpingitis - Possibility of sexually transmitted infection should be excluded (Ankum et al 1996)

Previous ectopic pregnancy (Bouyer et al 1996)

Failure of sterilisation
History of infertility
Increased Maternal age

2.1.2 Presentation

The patient typically presents with pain in one of the iliac fosse which may or may not be associated with vaginal bleeding. The pain and bleeding can be of varying severity. Sometimes the patient may pass decidual cast with vaginal bleeding which can be confused with product of conception.

2.1.3 Diagnosis

Ectopic pregnancy is difficult to diagnose clinically as most of the time the patient compensates for bleeding and not tachycardic or hypotensive unless significant intraperitoneal bleeding has taken place. Speculum examination of the cervix may be helpful in excluding miscarriage where the cervical os is open. Vaginal examination may show cervical excitation which, if positive, points towards ectopic pregnancy. However it is not a specific test for ectopic. Ultrasound scan is the investigation of choice. Also, in asymptomatic patients, serial BHCG can be checked to exclude ectopic pregnancy.

2.1.4 Management

There are two main treatment options- Surgical and Medical. An expectant approach may be taken in some selective asymptomatic patients with variable success.

Surgical: Laparoscopic salpingectomy is the surgical method of choice in hemodynamically stable patients. Compared to laparotomy, it is associated with less intraoperative blood loss, shorter operative time and shorter hospital stay (Murphy et al 1992 and Gray et al 1995)

If the patient is not hemodynamically stable, management should be by quickest method, which in most cases is by laparotomy. However, it does depend on surgeon's expertise (RCOG Guideline no 21). Crossmatched blood should be available prior to operation as it is difficult to predict the degree of haemorrhage.

If the contralateral tube is not healthy, a salpingotomy can be considered instead of salpingectomy to increase the chance of intrauterine pregnancy in future (Silva et al 1993)

Medical Management: Methotrexate is used for the management of ectopic pregnancy in a stable patient. The patient should always be counselled about the possibility of rupture. Lipscomb et al. (1998) has shown methotrexate to be as effective as surgery in suitable patients.

All mothers with Rh negative blood group should receive Anti D immunoglobulin (RCOG Guideline no 21).

3. Antepartum Haemorrhage

Antepartum Hemorrhage (APH) classically is described as any bleeding from the genital tract after 24 weeks of pregnancy. Spotting or minimal bleeding is common in pregnancy and cervical cause, such as ectropion should be ruled out first. If the patient is having regular contraction, heavy show (which is a sign of labour) should be ruled out as well.

There are two major causes of APH -Placenta previa & Placental Abruption which might need blood transfusion.

3.1 Risk assessment for APH

(RCOG. Green top Guideline No. 27 & National Collaborating Centre for Women’s and Children’s Health. Antenatal care: Clinical Guideline. 2003).

- During the anomaly/detailed ultrasound scan at 18-22 weeks:placental localisation should be done.
- Further scans after 30 weeks to confirm low-lying placenta,if placenta was found to be low in the earlier scans.
- Anaemia, if present to be corrected during antenatal period
- If previous caesarean section: exclude placenta accreta exclude placenta accreta in the third trimester
- In case of placental abruption: Remember that there might be concealed bleeding and not all of the bleeding is apparent.

3.2 Diagnosis of placenta previa

Placenta previa is defined as when the placenta covers the internal os of the cervix partly or fully in such a way as to prevent the baby’s head to deliver vaginally. It is one of the most important causes for maternal morbidity in obstetrics and contributes not only to Antepartum haemorrhage, but also post partum haemorrhage (Onwere et al 2011). It is divided into two categories by ultrasound scan: Major, when the placenta covers the internal os fully and minor, when it is close to internal os but does not cover it fully. Transvaginal ultrasound scan is vital in diagnosing placenta previa, especially when it is posterior (RCOG. Green top Guideline No. 27 & Leerentveld RA 1990).

Clinical Signs/symptoms
1. Recurrent painless vaginal bleeding in third trimester
2. Persistent malpresentation such as transverse lie, breech, oblique lie.
3. High presenting part in labour
Ultrasound Scan:
1. Suspect at anomaly scan (second trimester)
2. If placenta is low-lying in second trimester scan, confirm placental position in third trimester
3. Ultrasound scan if sufficient degree of suspicion ,even when the placenta is not noted to be low-lying in second trimester
4. Transvaginal ultrasound is safe and particularly useful in posterior placenta previa
5. Possible to diagnose placenta accreta or percreta by ultrasound scan.
MRI Scan: Reserved for suspected placenta accreta, percreta and increta

Table 1. Diagnosis of Placenta Previa.

3.3 Placental abruption

Abruption on the other hand is the separation of the placenta from the uterine wall. The bleeding resulting from the separation can be fully or partly revealed or sometimes can be

concealed. The problem of concealed bleeding is that a major internal haemorrhage can take place before the patient becomes symptomatic. Hence, it can be difficult to diagnose and manage. The patient typically presents in third trimester with severe abdominal pain and vaginal bleeding with or without intra-uterine fetal death. The uterus has classically been described as woody hard. Sheiner et al showed that the perinatal morbidity and mortality is significantly higher in placental abruption (OR = 30.0, 95% CI 19.7-45.6; p < 0.001). Common causes of placental abruption are mentioned in table 2.

3.3.1 Diagnosis of placental abruption

Diagnosis of placental abruption is mainly clinical. The patient commonly presents with abdominal pain and vaginal bleeding. Bleeding is generally less severe than placenta previa. It is important to rule out concealed bleeding. In case of significant abruption the CTG may show fetal distress or even intrauterine fetal death. The condition is sometimes complicated by disseminated intravascular coagulopathy. Management is by delivery of the baby if there is evidence of fetal distress. If there is intrauterine death, vaginal delivery can be considered after correction of coagulopathy. Management plan should be discussed with the anaesthetist, haematologist and paediatrician- if there is fetal distress or preterm delivery.

<ul style="list-style-type: none">• Pregnancy induced hypertension: pre-eclampsia and eclampsia (Ananth et al 1997)• Polyhydramnios or oligohydramnios (Hung et al 2007)• Cocaine misuse (Mbah et al 2011)• Trauma (OR = 10.0; 95% CI 3.9-25.5; P < 0.001) (Weintraub 2006)• Maternal diabetes (Dafallah & Babikir 2004)

Table 2. Common causes of abruption of placenta

3.4 Management of major antepartum haemorrhage

3.4.1 Management of placenta previa

Management of placenta previa depends on different factors. The first and foremost is the bleeding. If the mother is symptomatic, i.e. presents with severe vaginal bleeding, delivery is indicated. At this stage fetal maturity is irrelevant and delivery should be considered in the maternal interest. If the mother is in labour with known major degree placenta previa a prompt caesarean section is indicated. In this situation, senior help should be sought urgently and blood should be crossmatched. The mother should be counselled about possibility of caesarean hysterectomy beforehand. If the mother is asymptomatic and the fetus is still premature, conservative management is reasonable with or without hospital admission. If the mother is asymptomatic and fetus is matured, delivery by elective (planned) caesarean section is indicated.

Vaginal bleeding in case of placenta previa is sudden and can be moderate to severe. Usually it is preceded by repeated 'warning' bleeds. The CTG of the fetus usually does not show any abnormality.

Elective caesarean section is the method of choice for the delivery of the fetus, but many patients need emergency caesarean section for moderate to severe unexpected bleeding. In

case of major placenta previa, when an anterior placenta covers the whole lower segment, caesarean section can be technically difficult and complicated by severe haemorrhage; hence it should be performed electively by a senior obstetrician with senior anaesthetist caring for the woman and senior paediatrician caring for the baby. The risk of massive haemorrhage and possibility of hysterectomy should be discussed with the patient prior to the operation if time permits and should be documented in the consent as both the risks are considerably higher (about 12 times more chance of blood transfusion and about one third might need hysterectomy). Delivery should be considered in asymptomatic placenta previa around 38 weeks of gestation. Some units offer in patient management from third trimester in cases of major placenta previa. In these cases two units of cross matched blood should be kept in fridge which should be replaced by newly crossmatched blood every week (British Committee for Standards in Haematology. Blood Transfusion Task Force 2004). The decision for delivery should be made by the consultant obstetrician and proper evaluation of each case is required.

Management of symptomatic Placenta previa (The MOET course Manual): Communication is the key to proper management. It is easy to underestimate bleeding, hence weighing of the sheets will be more accurate indicator of the amount of blood loss. The management of acute bleeding has been outlined in table 3.

<ul style="list-style-type: none">• Manage Airway, Breathing, Circulation• Assessment of the bleeding• Intravenous access: 2 large bore (16 gauge) cannulae• Blood for Full Blood count, coagulation profile, Crossmatch• Indwelling catheter to monitor urine output• Fluid resuscitation• Crossmatch bloods and availability of blood products: alert Blood Transfusion that more blood may be needed• Alert: Senior-most Obstetrician, Anaesthetist, Paediatrician, Hematologist, Blood Transfusion Service• If life threatening bleeding – consider group specific or O negative blood• Decision for delivery/conservative management: Senior Obstetrician should be involved.

Table 3. Management of symptomatic Antepartum haemorrhage

3.4.2 Management of major placental abruption

In case of suspected significant abruption, delivery is indicated in both maternal and fetal interest. In severe placental abruption, delivery by caesarean section is indicated. If the mother presents with signs of abruption with a viable fetus which is distressed, prompt delivery improves outcome (Kayani et al 2003). If the mother is symptomatic and the fetus is already dead, artificial rupture of membrane can be performed and a trial for a vaginal delivery can be undertaken. However, if the bleeding is severe, then caesarean section might be the appropriate mode of delivery in maternal interest irrespective of the status of the fetus.

4. Postpartum Haemorrhage (PPH)

4.1 Introduction

It is one of the most common causes for maternal mortality and morbidity worldwide. In Scotland, the rate of life-threatening haemorrhage is about 3.7/1000 (Brace, Kernaghan & Penney 2007). Life threatening haemorrhage includes bleeding more than 2.5 litres or the patients who need treatment to correct coagulopathy or where more than five units of blood have been transfused.

The WHO has defined postpartum haemorrhage as any bleeding from the genital tract over 500mls.after the delivery of the baby. In the developed world, most mothers show no sign of hypovolemia till 1000 mls of blood is lost (Drife 1997). Hemorrhage within 24 hours of delivery is termed as primary and a haemorrhage after 24 hour is termed as secondary.

Common causes of PPH are uterine atony, vaginal or cervical trauma, retained placental tissue or membranes and Disseminated Intravascular Coagulopathy (DIC), out of which the commonest being uterine atony (70%), where the uterus fails to contract after delivery. This is a situation where urgent action is life-saving and may require transfusion of multiple units of blood and blood products. The clotting factors are exhausted quickly and unless they are replenished as part of resuscitation, there is little chance that bleeding will be controlled by simply blood transfusion. However, prompt action and transfusion of blood and blood products can save life and even preserve uterus in cases of massive haemorrhage.

4.2 Strategies to prevent major Post Partum Haemorrhage

It is possible to prevent major obstetric haemorrhage and subsequent blood transfusion in majority of the anticipated cases.All the factors mentioned in table 4 have been identified as risk factors for PPH and if the patient is at higher risk ,it should be clearly documented in the notes and communicated to the relevant health professionals. In four cochrane reviews active management of third stage of labour has been found superior to physiological third stage (Prendiville 2000). Active management of third stage include early cord clamping, controlled cord traction and early uterotonic drugs such as syntocinon,ergometrine or syntometrine as per local protocol. Proper risk assessment in the antenatal period and individualisation of cases are the vital steps which must be taken in order to prevent blood transfusion.

<ul style="list-style-type: none">• Parity: Primiparity or Grand Multiparity• Prior Caesarean section (Kramer et al 2011)• Placenta previa or low-lying placenta, marginal umbilical cord insertion in the placenta• Past history of PPH• Placenta previa or accreta in previous pregnancy	<ul style="list-style-type: none">• Labour induction and augmentation (Kramer et al 2011)• Prolonged labour• Uterine or cervical trauma at delivery• Transverse lie• Gestational age < 32 weeks• Birth weight ≥ 4500 g.• Multiple pregnancy
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Table 4. Risk factors for PPH

4.3 Management of major Post Partum Haemorrhage

Most of the time PPH is unpredictable and pose major health concern when they are severe. If PPH is anticipated proper steps should be taken to reduce the likelihood of blood transfusion and maternal morbidity. These steps include use of cell salvage if available, support from senior obstetrician, senior anaesthetist and other health professionals.

Uterus should be rubbed up for a contraction should be the first step and sometimes this is enough to reduce blood loss. Pharmacological agents such as oxytocin, ergometrine and prostaglandins (intramuscular or Intramyometrial) injections remain the mainstay of management. Effective communication between the health professionals is important as resuscitation should run side by side to the definitive management.

If bleeding is uncontrollable with pharmacological agents, surgical measures such as Brace sutures, Examination under anaesthesia (EUA) and repair of cervical or uterine injury are undertaken. Intrauterine Balloon is one of the most common and effective method of controlling moderate to severe PPH.

If facilities permit, Interventional radiologist and haematologist should be involved early as often the PPH can lead to DIC and will be requiring expert input. The interventional radiologist will play a key role if the bleeding is from any branch of internal or external iliac artery. If this facility is not available either hysterectomy or transfer of the patient to a tertiary referral centre after stabilisation should be considered.

<ul style="list-style-type: none">• Assessment of Bleeding• Indwelling Catheter• Rubbing up a contraction• Ask for help• Multidisciplinary approach, including Senior obstetrician, senior anaesthetist, Senior midwives,• Airway, Breathing and circulation• 2 large bore cannulae• Frequent monitoring of BP, Pulse, oxygen saturation, urine output and vaginal bleeding
Medical Management: <ul style="list-style-type: none">• Oxytocin bolus• Oxytocin infusion• Ergometrine• Prostaglandin: Intramuscular, Intramyometrial, Per-rectal
Surgical Management: <ul style="list-style-type: none">• Brace sutures• Intrauterine Balloon• Internal Iliac artery ligation• Hysterectomy
Interventional Radiology
Recombinant factor VII concentrate: Not licensed for use in the UK for treatment of PPH

Table 5. Summary of Management of PPH

Recombinant Factor VII concentrate (rFVIIa): Not licensed for use for obstetric haemorrhage, but can be used when benefit outweighs risk. Senior haematologist should always be involved in the decision making. Franchini, Lippi & Franchi, in a review of published data of 65 women treated with rFVIIa for PPH, suggested that rFVIIa reduced bleeding.

Hysterectomy should be considered as a last resort. A timely hysterectomy can save life.

5. Blood transfusion in APH & PPH

Ideally, fully cross matched blood is preferable in case of major obstetric haemorrhage. However, obstetric haemorrhage is extremely unpredictable and it is not always possible to wait for fully cross matched blood. Generally volume replacement should start with up to 2 litres of crystalloid. Plasma expanders should follow until the blood is available (The MOET course Manual). If the haemorrhage is life-threatening, O negative or type specific blood should be used. In most hospitals O negative blood is readily available either in the labour suite or at the on-site blood bank. Patients, who are at higher risk of haemorrhage, should be admitted and delivered in a unit where blood and blood products are readily available (CEMACH Sixth Report, 2004).

6. Risk management

Availability of blood does not always guarantee best standard of care to the patients. Standard of care depends on the team-work and competence of the healthcare professionals. Two strategies can be employed to improve these factors. The doctors and other healthcare professionals should attend appropriate course to maintain their skills and update their knowledge of both resuscitation and managing obstetric emergencies to improve health professionals' knowledge. The other important step is to organise regular obstetric emergency drills (commonly known as obstetric fire drills in the UK).

A local protocol should be in place to manage major obstetric haemorrhage and regular audit of practice and analysis of cases with major blood loss should be carried out. This is vital as lessons are to be learned from every mistake made to improve patient care in future. Also, emphasis should be given to the importance of appropriate and detailed documentation including the timings of steps of medical and surgical management.

7. Morbidly adherent placenta

The Royal College of Obstetricians and Gynaecologists (UK) have brought out an excellent guideline (Green top Guideline No. 27) on the management of morbidly adherent placenta (placenta accreta, increta and percreta). From the guideline and searching other literature, the salient points are:

- The incidence of placenta previa accreta is on the rise as the incidence of caesarean section is rising
- The patient should be reviewed by the consultant obstetrician and consultant anaesthetist in the antenatal period and a proper plan should be documented.
- The consent form should include discussion about Interventional Radiology, Cell salvage, Recombinant Factor VII concentrate and hysterectomy.

- Interventional Radiology can be safely and effectively used for an elective caesarean section (Jung et al 2011). Intra-arterial balloon can be inserted before the procedure.
- At caesarean section the uterus should be opened distal to the placenta so that the baby can be delivered undisturbed and to have the option of conservative management.
- If the placenta is covering the whole anterior lower segment, a midline skin incision will not be unreasonable.
- If the placenta fails to separate at caesarean section and bleeding is minimal, it can be left in situ. Attempting placental separation risks hysterectomy in up to 100% of cases (Eller et al 2009). If there is major haemorrhage, the uterine wound should be closed and a subtotal or total hysterectomy can be performed.
- If the placenta is left behind serial ultrasound scan and beta HCG monitoring should be performed. Post operative antibiotics should be given to minimise the risk of infection and close monitoring is needed to diagnose infection early.

8. Interventional radiology in anticipated intrapartum and postpartum haemorrhage

In case of major placenta previa or known morbidly adherent placenta, interventional radiology can be used to minimise the risk of potential PPH. The Radiologist may insert the balloons preoperatively either in the uterine artery or in the anterior division of internal iliac artery which can be inflated preoperatively to minimise in case of uncontrollable haemorrhage or even can be used for embolisation. The overall success rate of interventional radiology in controlling bleeding and avoidance in hysterectomy rate has been quoted around 71-97% (Dildy GA 3rd 2002 & Hong et al 2004)

In a large study (involving sixty six women, who have undergone embolisation) in Boston, USA, Ganguly et al suggested that the 'threshold for Uterine Artery Embolisation in women with PPH should be low, as it is associated with a high clinical effectiveness rate and a low complication rate'.

9. Cell salvage

Cell salvage is an effective way of reducing blood transfusion rate in women where the anticipated blood loss is more than 1.5 litres (RCOG Green top guideline no. 47). Prior consent is necessary for this procedure. In intra-operative cell salvage blood is collected usually after the liquor is drained then collected in a reservoir centrifuged, washed and processed for transfusion. In a case series in a large maternity unit in the UK, introduction of cell saver has been a major factor in reducing heterologous blood transfusion from 10.2% to 7.9% (King et al 2009). The main problem with this process is that there is no available filter to filter out fetal cells. Hence, a Kleihauer test is necessary after its use.

10. Management of patients refusing blood transfusion on religious/ethical belief

Some women, mostly due to their religious belief, decline blood or blood products transfusion. Most common of these groups are Jehovah's witnesses and transfusing them under any circumstances without their consent may be considered as to assault, hence

should not be undertaken even if it is indicated. In UK, legally a woman can decline treatment even if it might prove fatal. But this is a decision, only a competent patient can make and no one else. Also, if she has declined transfusion, no one else can make a decision on her behalf to transfuse her.

A detailed discussion regarding the risks should take place at first or second trimester. The discussion should also include possibility of hysterectomy, morbidity and possibility of death. Two large case series in UK (Massiah et al 2007) and USA (Singla et al 2001) looked into the obstetric outcome of the labour and deliveries in Jehovah's witnesses. The reported mortality rate is 65 fold higher in the UK and 44 fold higher in USA.

A written consent should be taken during the antenatal period after a detailed discussion about pros and cons of the decision. Anaemia should be corrected aggressively before delivery, if necessary with intravenous iron therapy. Prior consent about cell salvage should be taken if the patient is due to have elective caesarean section or even in emergency caesarean section if time and facilities permit. This cell salvage should run in continuous loop without disconnection till the end of the procedure (Currie et al 2010). In these patients prompt decision making about prevention of PPH and using all the relevant uterotonics and surgical methods (intrauterine compression balloon, brace sutures, interventional radiology) are vital and if necessary hysterectomy should be undertaken sooner rather than later. The patient's wishes should be respected and it is not legally and ethically justified to transfuse her against her wishes. Senior input from the obstetric and anaesthetic consultants should be sought early.

11. Acknowledgement

Dr. Pauline Lynch, Consultant Obstetrician and Dr. Antony Nicoll, Consultant Obstetrician Ninewells Hospital for their whole hearted support. Royal College of Obstetricians and Gynaecologists for their guidelines on Placenta Previa (no.27), Blood Transfusion in pregnancy (no.47) and Post partum Haemorrhage (no.52)

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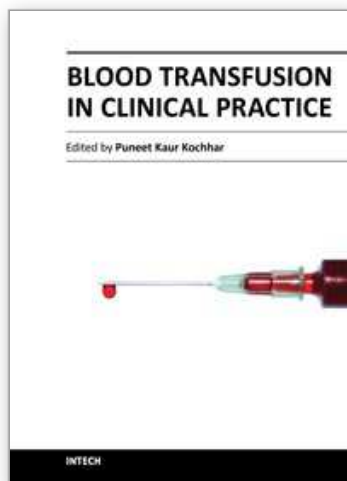
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Blood Transfusion in Clinical Practice

Edited by Dr. Puneet Kochhar

ISBN 978-953-51-0343-1

Hard cover, 272 pages

Publisher InTech

Published online 16, March, 2012

Published in print edition March, 2012

Blood Transfusion in Clinical Practice focuses on the application of blood transfusion in different clinical settings. The text has been divided into five sections. The first section includes a chapter describing the basic principles of ABO blood group system in blood transfusion. The second section discusses the use of transfusion in various clinical settings including orthopedics, obstetrics, cardiac surgery, etc. The third section covers transfusion transmitted infections, while section four describes alternative strategies to allogenic blood transfusion. The last section speculates over immunomodulatory effects of blood transfusion.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Subhayu Bandyopadhyay (2012). Scope of Blood Transfusion in Obstetrics, Blood Transfusion in Clinical Practice, Dr. Puneet Kochhar (Ed.), ISBN: 978-953-51-0343-1, InTech, Available from:
<http://www.intechopen.com/books/blood-transfusion-in-clinical-practice/scope-of-blood-transfusion-in-obstetrics>

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中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
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