The Use of Blood in Obstetrics and Gynecology in the Developing World

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Access to safe blood is critical in comprehensive emergency obstetric care and for reducing maternal mortality. Many countries have inadequate blood supplies, and this disproportionately affects women and children in need of life-saving blood transfusions. Although preventative measures aimed at reducing postpartum hemorrhage by treating underlying anemia and infectious diseases are critical, they are insufficient for obstetric hemorrhage. In the developing world, efforts should focus on alternative means of providing safe blood in cases of hemorrhage, with particular focus on rapid testing, donation of warm whole blood, and autologous blood transfusion.
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Key words: Blood transfusion • Obstetric hemorrhage • Warm whole blood • Autologous blood transfusion

In the developed world, blood is most frequently used in surgical procedures or to treat advanced medical diseases such as chemotherapy-related anemia. However, in the developing world, where blood and transfusion services are often lacking, obstetric complications are the leading indication for transfusion (Figure 1). Blood transfusion is recognized as one of the eight essential components of comprehensive emergency obstetric care (cEmOC), which has been shown to reduce rates of maternal mortality.[1,2] Efforts to reduce the number of maternal deaths from hemorrhage should address both the availability of blood and transfusion services as well as other means to prevent and treat hemorrhage that do not rely solely on allogenic blood transfusions.

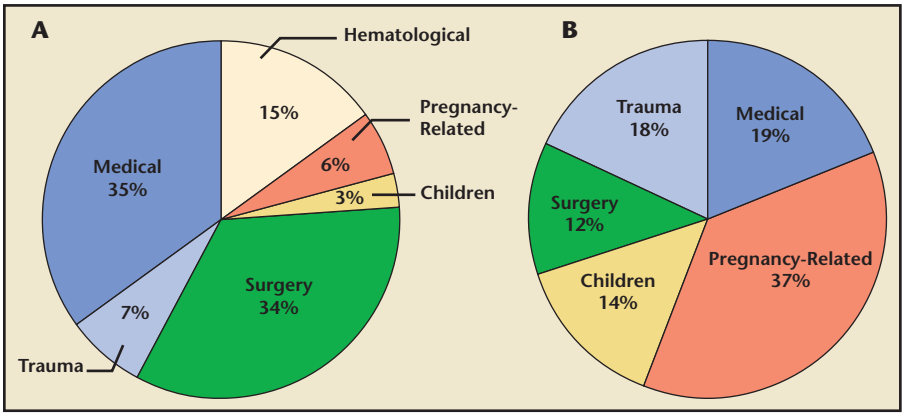

Figure 1. (A) *Estimated use of red cell transfusion in developed countries.* (B) *Estimated use of red cell transfusion in developing countries. Reproduced with permission from World Health Organization.*[5]

Background

Hemorrhage continues to be the leading cause of maternal mortality worldwide, accounting for 34% of maternal deaths in Africa, 31% in Asia, 21% in Latin America, and 13% in developed countries.[3] Although efforts have centered on prevention of postpartum hemorrhage by administration of uterotonics and active management of the third stage of labor, women continue to die of inadequate blood banking. In sub-Saharan Africa, it is estimated that 26% of maternal hemorrhagic deaths are a direct consequence of the lack of blood transfusion services, and globally up to 150,000 pregnancy-related deaths could be avoided each year if women had access to safe blood.[4,5]

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Challenges

According to the World Health Organization (WHO), the four cornerstones of a safe and effective blood donor service are a national system, volunteer donations, blood testing, and avoidance of unnecessary transfusions.[5] Each of these cornerstones poses challenges in developing countries, where infrastructure may be limited; the cost of blood procurement, screening, and storage is high; and blood donation is rare.

The number of blood donations per 1000 people can be used as a proxy for the availability and adequacy of the blood supply in a given country, with developing countries typically having the lowest rates of donation. Lack of blood directly affects maternal mortality, and as Figure 2 demonstrates, it is not surprising that developing countries such as those in sub-Saharan Africa, with the lowest donation rates ($< 5/1000$ versus $> 30/1000$ in many developing countries), also suffer from high rates of maternal mortality. At a minimum, WHO estimates that a country needs available blood supply that is equivalent to 1% to 2% of its population.

Ensuring blood safety is also of utmost importance, as transfusion can transmit human immunodeficiency virus (HIV), hepatitis, syphilis, Chagas disease, and malaria. In 2002, 5% to 10% of newly acquired HIV infections were related to infected blood transfusions.[6] As women and children are the most likely recipients of blood in areas of both high HIV prevalence and blood supply shortages, they are at disproportionately high risk.[7] One unit of blood can be procured, screened, and tested for approximately US$40, and although this is a high price in many resource-poor countries, WHO points out that it is ultimately cheaper than the cost of HIV transmission or morbidity associated with having no safe blood available.

Cultural Considerations

Variations in religious and cultural beliefs about blood contribute to lower rates of voluntary donations and transfusion acceptance in certain populations. In many countries in Africa, for example, blood donors are typically replacement donors, or people who donate specifically to aid a family member who needs or will soon need blood. Because blood defines family bonds, these populations may be less likely to donate blood for the benefit of a stranger.[8] Other beliefs, such as fears of losing strength, not having enough

Other beliefs, such as fears of losing strength, not having enough blood, or depletion of life force reduce voluntary donation in surveyed African and Chinese groups. Suspicion that blood is being sold as a commodity for the benefit of Westerners or for use in witchcraft also limits acceptance of blood donation in certain communities.

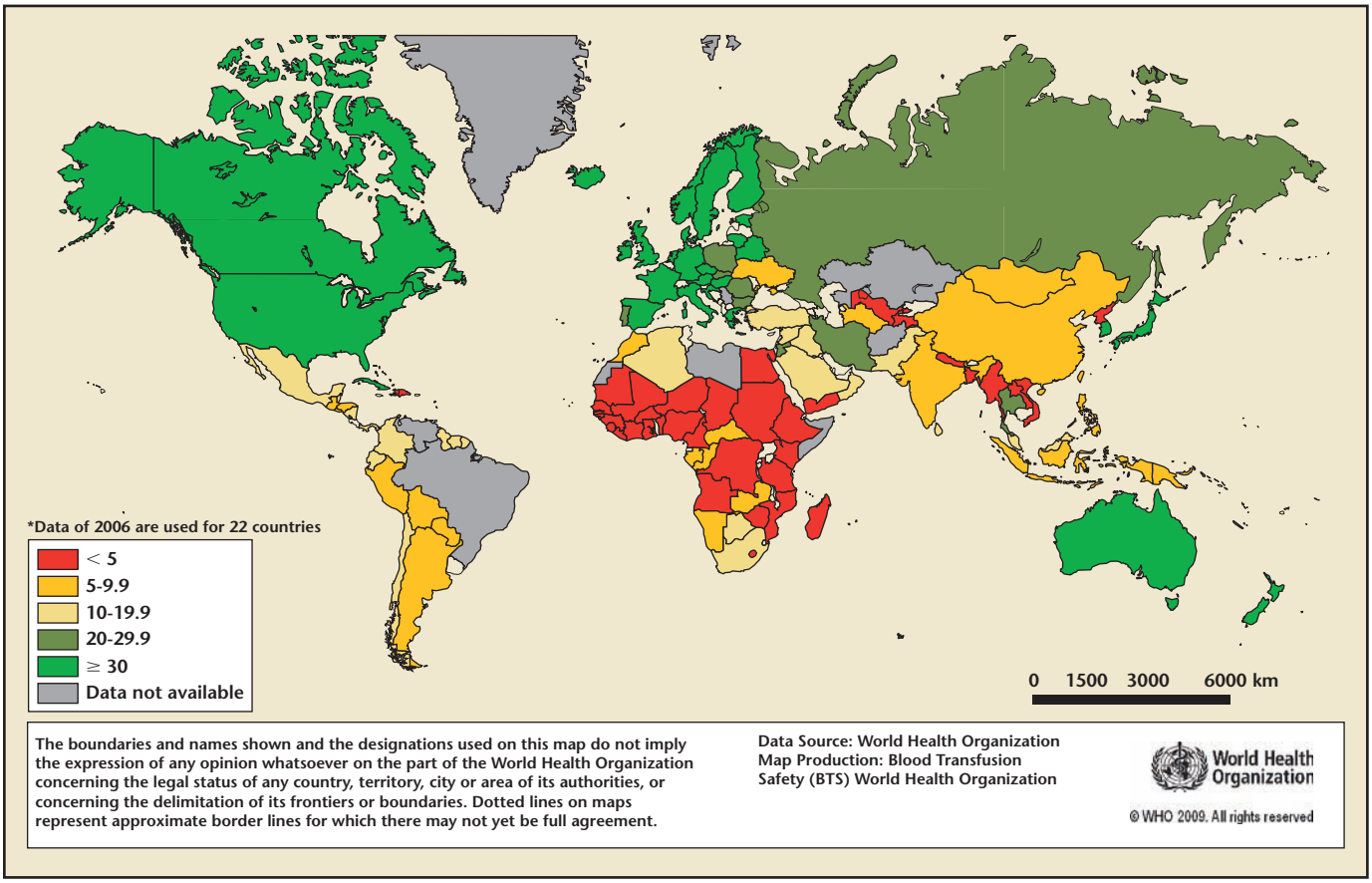

Figure 2. *Blood donations per 1000 population (2007). Reproduced with permission from World Health Organization. http://www.who.int/mediacentre/factsheets/donations_per1000_population_20091110.pdf.*

blood, or depletion of life force reduce voluntary donation in surveyed African and Chinese groups.[9,10] Suspicion that blood is being sold as a commodity for the benefit of Westerners or for use in witchcraft also limits acceptance of blood donation in certain communities.[8]

A review of maternal deaths in the United Kingdom in 2002 determined that women who refused blood transfusions had higher death rates than those who accepted blood products. In a subsequent survey, religious beliefs (primarily those of Jehovah's Witnesses) and fear of disease transmission were the two primary reasons for refusal. Another survey of Jordanian women cited fear of complications as the most frequent reason women would refuse a blood transfusion. Blood transfusion should be discussed with pregnant women as early as possible so that misconceptions can be addressed or alternate treatment options considered should the need for blood arise.[11,12]

Solutions

Although efforts are ongoing to increase blood donations and improve blood supply through national banking systems in developing countries, other improvements to maternal health need to be explored. For example, where HIV or the hepatitis C virus (HCV) is endemic, predonation rapid testing has been proposed to decrease the overall cost of blood banking by reducing the amount of blood discarded when found to be viral screen positive.[13] In postpartum hemorrhage, rapid screens are useful if willing donors are available when prescreened blood is not. In fact, the use of warm whole blood in place of blood components (like packed red blood cells or plasma) is often essential. Recent data from combat trauma warrant more research into the advantages of warm whole blood over stored blood components.[14]

Other alternatives to allogenic blood transfusion proposed to circumvent the difficult issues of donation, testing, safety, storage, and cost include preoperative autologous blood donation, perioperative hemodilution, and intraoperative autologous transfusion.

Preoperative Autologous Blood Donation and Perioperative Hemodilution

Preoperative autologous blood donation has been proposed to reduce the need for allogenic blood in pregnancies at high risk for hemorrhage because it greatly reduces the infectious and immunologic risks of blood transfusion. Although predonation has been shown to be safe and effective in managing pregnancies complicated by high-risk conditions such as placenta previa or placenta accreta, it does require an established blood banking system.[15] Furthermore, predonation appears to be well tolerated by women in the third trimester of pregnancy, but those studies were in women in the developed world, where other problems contributing to baseline anemia such as malnutrition, malaria, and HIV are not as prevalent.[16] Finally, a system of predonation assumes accurate predication of a particular patient's risk of hemorrhage, which is rarely the case.

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Acute normovolemic hemodilution is another perioperative strategy to limit the need for allogenic blood transfusions. A patient exchanges some of her own blood for an equal volume of crystalloid, diluting the blood and technically limiting the amount lost in the surgical field. At the end of the procedure, her own blood is retransfused, restoring the hematocrit. Benefits include preserving the freshness of the blood, including other essential components such as platelets and clotting factors. Although this approach has been successful in cases of malplacentation, it should be used with caution because pregnant women are already in physiologic hemodiluted anemia.[15,17]

Autologous Transfusion

Intraoperative autologous blood transfusion has a long history in the treatment of hemorrhage from ruptured ectopic pregnancies, and is frequently and safely used in areas with minimal resources. In both developed and developing countries, autologous transfusion is effective and safe and avoids risks such as ABO incompatibility, infection, and blood storage problems. Whereas developed countries have used blood salvage devices such as the Cell Saver® (Haemonetics Corp., Braintree, MA) to process and retransfuse salvaged blood, several simple manual systems have also been described.[18]

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The success and safety of the Tanguieta funnel was demonstrated in a review of over 200 cases of blood salvage and autotransfusion for the treatment of ruptured ectopic pregnancy in Benin, West Africa (Figure 3).[19] A perforated funnel is placed in the peritoneal cavity to collect blood. After clots and debris are filtered out, the blood is then aspirated with a sterile syringe and injected into transfusion bags preprepared with citrate-phosphate-dextrose-adenine (CPDA) anticoagulant solution. All manual systems rely on some version of retrieval, filtering, and reinfusion.[18] Other methods described in the literature use various collecting devices such as a sterile soup ladle[20] or a small sterile dish to collect the blood, sterile gauze to filter the blood, and sterile glass bottles with rubber tops for reinfusion (Figure 4). If CPDA solution is not readily available, the tubing can be heparinized. Of note, automated blood salvage devices (such as the Cell Saver) do not appear to offer advantages over manual devices, although no comparisons have been made in randomized trials.

Whereas autologous blood transfusion is well established for ruptured ectopic pregnancy, there are few data on the safety and efficacy of autotransfusion for postpartum hemorrhage. Exploration of autotransfusion as a treatment modality has been stymied by the theoretical risks of amniotic fluid embolus (AFE) and infectious complications. However, one

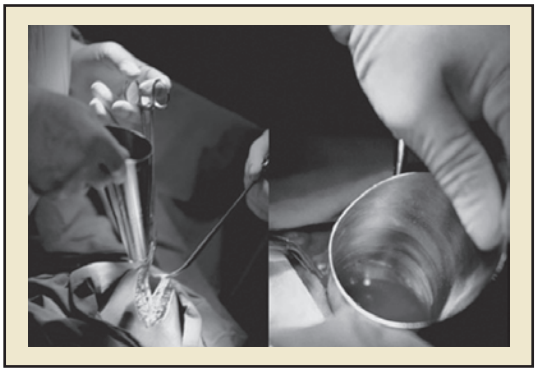

Figure 3. *Setting up a Tanguieta funnel for blood collection in hemoperitoneum. Reproduced with permission from Priuli G et al.*[19]

Figure 4. *Filtering blood through gauze into sterile bottles for subsequent autotransfusion in a ruptured ectopic pregnancy. Photo courtesy of Julianna Schantz-Dunn.*

historical cohort study of 139 patients undergoing autotransfusion at cesarean delivery showed no increased risk of complications compared with allogenic blood transfusion and reported no cases of AFE.[21] One group of authors suggest that ". . . as our understanding of the pathophysiology of AFE has increased, it could be argued that this theoretical risk has been overestimated" and call for a trial to accurately assess the risks and benefits of cell salvage at cesarean delivery.[22] For countries with limited resources, this study would need to evaluate outcomes from autologous transfusion using manual as well as automated devices.

Conclusions

Although we acknowledged World Blood Donor Day on June 14, 2011, we must not forget that blood remains scarce in many parts of the world. For women and children this too often has deadly consequences.

Until adequate national blood banks are in place, we should continue to explore alternatives to allogenic blood transfusion for obstetric and gynecologic hemorrhage. Treatments such as fibrinogen recombinant factors (which are stored in powder form and do not require refrigeration) would be useful in many resource-poor settings, but are still prohibitively expensive. Autologous transfusion holds promise even in the treatment of postpartum hemorrhage, and efforts should be undertaken to develop safe and simple techniques. ■

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Main Points

- In sub-Saharan Africa, it is estimated that 26% of maternal hemorrhagic deaths are a direct consequence of the lack of blood transfusion services, and globally up to 150,000 pregnancy-related deaths could be avoided each year if women had access to safe blood.
- According to the World Health Organization (WHO), the four cornerstones of a safe and effective blood donor service are a national system, volunteer donations, blood testing, and avoidance of unnecessary transfusions.
- Blood transfusion should be discussed with pregnant women as early as possible so that misconceptions can be addressed or alternate treatment options considered should the need for blood arise.
- Alternatives to allogenic blood transfusion proposed to circumvent the difficult issues of donation, testing, safety, storage, and cost include preoperative autologous blood donation, perioperative hemodilution, and intraoperative autologous transfusion.

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