intact survival *versus* a negative outcome (new permanent disability or death).[2] We don't consider surviving in a coma or with a stroke to be a successful outcome.

All of our AFE patients who received rVIIa also had surgery to control hemorrhage. We therefore chose AFE patients who had surgery to control hemorrhage but did not receive rVIIa as our comparison cohort. Patients who die very rapidly of AFE generally expire before surgical intervention or rVIIa treatment can be given.

We agree that identifying cases through a prospective, population-based reporting mechanism such as UKOSS is an excellent way to identify the incidence of complications. However, we are seriously concerned that the broad definition of AFE, including patients without coagulopathy, and the lack of information on morbidity weaken the ability of UKOSS to assess rVIIa complications in AFE patients.

Patients with AFE have high circulating levels of tissue factor, which is why rVIIa treatment is particularly risky both in theory and in practice.[2] We urge UKOSS and the rest of the obstetric community to explore the use of potentially safer hemostatic alternatives, such as fibrinogen concentrate and tranexamic acid, rather than prematurely embracing rVIIa, the agent with the greatest potential for thrombotic complications.

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References

1. Knight M, Tuffnell D, Brocklehurst P, Spark P, Kurinczuk JJ, UK Obstetric Surveillance System: Incidence and risk factors for amniotic-fluid embolism. Obstet Gynecol 2010; 115:910–7
2. Leighton BL, Wall MH, Lockhart EM, Phillips LE, Zatta AJ: Use of recombinant factor VIIa in patients with amniotic fluid embolism: A systematic review of case reports. ANESTHESIOLOGY 2011; 115: 1201–8
3. Tuffnell DJ: United Kingdom amniotic fluid embolism register. BJOG 2005; 112:1625–9
4. Clark SL, Hankins GD, Dudley DA, Dildy GA, Porter TF: Amniotic fluid embolism: Analysis of the national registry. Am J Obstet Gynecol 1995; 172:1158–69
5. Lim Y, Loo CC, Chia V, Fun W: Recombinant factor VIIa after amniotic fluid embolism and disseminated intravascular coagulopathy. Int J Gynaecol Obstet 2004; 87:178–9
6. Prosper SC, Goudge CS, Lupo VR: Recombinant factor VIIa to successfully manage disseminated intravascular coagulation from amniotic fluid embolism. Obstet Gynecol 2007; 109:524–5

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Flow Chart for Amniotic Fluid Embolism Management: A Tricky Tool

To the Editor:

We read with interest the educational case scenario of amniotic fluid embolism (AFE) by Dean *et al.*[1] The authors propose a flow chart for clinical management of AFE. However, we believe that the authors' diagram may depict an oversimplified approach for acquired coagulopathy during the course of AFE.

Although coagulopathic bleeding is not absolutely necessary for the diagnosis of AFE, it is still a prominent feature and one of the most challenging complications for which appropriate early intervention is crucial. The event of AFE introduces both procoagulant and anticoagulant factors into the maternal bloodstream, and ensuing imbalance of coagulation can evolve into disseminated intravascular coagulation. Alternatively, coagulopathy can result from the dilution of procoagulant factors after aggressive fluid resuscitation. The exact mechanism of bleeding during AFE remains unclear and is likely multifactorial, but hypofibrinogenemia is frequently reported.[2,3] Delayed fibrinogen replacement can impair hemostasis and increase morbidity and mortality from inadequate clot formation, ongoing hemorrhage, acidosis, and hypothermia.

Cryoprecipitate is mentioned in the case scenario, although the use of fibrinogen-rich products, such as cryoprecipitate or fibrinogen concentrate, is not mentioned in the flow chart or emphasized in the discussion section. The flow chart proposed by Dean *et al.* suggests considering hysterectomy, recombinant factor VIIa, or uterine artery embolization for persistent uterine hemorrhage, and discontinuation of resuscitation if these efforts do not achieve hemostasis. Early fibrinogen replacement should be emphasized, and the use of recombinant factor VIIa discouraged except for cases of hemorrhage refractory to massive component transfusion. We urge caution on the use of recombinant factor VIIa when AFE is suspected, as a recent analysis of such cases revealed that the use of recombinant factor VIIa was associated with significantly increased major organ thrombosis and death.[3]

The Food and Drug Administration approved fibrinogen concentrate (RiaSTAP) for treatment of congenital hypofibrinogenemia in 2009, and its successful use has been reported in the management of disseminated intravascular coagulation related to both AFE[2,3] and postpartum hemorrhage.[4] In contrast to cryoprecipitate, which takes 30–60 min to thaw before use, fibrinogen concentrate can be reconstituted and administered rapidly. Stocked at room temperature in lyophilized form, fibrinogen concentrate is a viable option even in remote locations. Moreover, it requires much less volume infused to restore adequate fibrinogen for clot integrity than cryoprecipitate or fresh frozen plasma.[5]

Although there may be no flow chart that perfectly captures every potential decision point, we believe that careful coagulopathy control plays a major role in survival after AFE, and deserves more emphasis. We suggest expansion of the flow chart with greater attention on coagulopathy management. Clearly defined transfusion guidelines can be integrated with institution-specific transfusion protocols, and along with staff education, may improve AFE-related hemorrhage management.[6] Amendments to the existing flow

chart may have major implications, because AFE is the second leading cause of maternal death in developed countries and near-miss morbidity is often a modifiable precursor.[7]

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References

1. Dean LS, Rogers RP 3rd, Harley RA, Hood DD: Case scenario: Amniotic fluid embolism. ANESTHESIOLOGY 2012; 116:186–92
2. Annecke T, Geisenberger T, Kürzl R, Penning R, Heindl B: Algorithm-based coagulation management of catastrophic amniotic fluid embolism. Blood Coagul Fibrinolysis 2010; 21:95–100
3. Leighton BL, Wall MH, Lockhart EM, Phillips LE, Zatta AJ: Use of recombinant factor VIIa in patients with amniotic fluid embolism: A systematic review of case reports. ANESTHESIOLOGY 2011; 115:1201–8
4. Bell SF, Rayment R, Collins PW, Collis RE: The use of fibrinogen concentrate to correct hypofibrinogenaemia rapidly during obstetric haemorrhage. Int J Obstet Anesth 2010; 19: 218–23
5. British Committee for Standards in Haematology, Stainsby D, MacLennan S, Thomas D, Isaac J, Hamilton PJ: Guidelines on the management of massive blood loss. Br J Haematol 2006; 135:634–41
6. Rizvi F, Mackey R, Barrett T, McKenna P, Geary M: Successful reduction of massive postpartum haemorrhage by use of guidelines and staff education. BJOG 2004; 111:495–8
7. Geller SE, Rosenberg D, Cox SM, Brown ML, Simonson L, Driscoll CA, Kilpatrick SJ: The continuum of maternal morbidity and mortality: Factors associated with severity. Am J Obstet Gynecol 2004; 191:939–44

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In Reply:

We thank Holck *et al.* for their interest in our publication and comments regarding our flow diagram guiding the management of amniotic fluid embolism.[1] The format of our case scenario was intended to be an overview of the presentation and management of amniotic fluid embolism, and the purpose of the flow chart was to serve as a very general educational guide toward management options. It was not meant to be a completely exhaustive algorithm of clinical analysis and treatment course.

However, we appreciate the authors suggesting the possibility of using fibrinogen concentrate as a newer alternative blood product therapy. We acknowledge that there may be a benefit of rapid low-volume bolus administration when compared with the delay encountered to thaw fresh frozen plasma or cryoprecipitate. However, use of fibrinogen concentrate also relies on its availability. Neither our community-based obstetric unit nor our level I trauma university hospital has fibrinogen concentrate readily available, and we suspect the same may be true of many institutions. It is also important to recognize that the dose and timing of administration of alternative blood products remains controversial.[2,3] As was discussed both in our case scenario and emphasized by Holck *et al.*, the use of factor VII should only be considered in cases of hemorrhage refractory to other therapies due to the risk of embolic consequences. Caution should also likely be exercised for fibrinogen concentrate because larger prospective studies are needed to determine its clinical efficacy and safety.[3]

Holck *et al.* are correct in stating that there is probably no flow chart that would direct every possible available therapy in managing the coagulopathy and the hemodynamic presentation of cases of amniotic fluid embolism. We would like to reemphasize the importance of having a transfusion protocol for massive obstetric hemorrhage, regardless of etiology. A multidisciplinary approach with specific guidelines outlining rapid, early, and aggressive intervention and resuscitation is likely to optimize maternal outcomes.[4,5]

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References

1. Dean LS, Rogers RP 3rd, Harley RA, Hood DD: Case scenario: Amniotic fluid embolism. ANESTHESIOLOGY 2012; 116:186–92
2. Bell SF, Rayment R, Collins PW, Collis RE: The use of fibrinogen concentrate to correct hypofibrinogenaemia rapidly during obstetric haemorrhage. Int J Obstet Anesth 2010; 19:218–23
3. Sørensen B, Tang M, Larsen OH, Laursen PN, Fenger-Eriksen C, Rea CJ: The role of fibrinogen: A new paradigm in the treatment of coagulopathic bleeding. Thromb Res 2011; 128 Suppl 1:S13–6
4. Skupski DW, Lowenwirt IP, Weinbaum FI, Brodsky D, Danek M, Eglinton GS: Improving hospital systems for the care of women with major obstetric hemorrhage. Obstet Gynecol 2006; 107:977–83
5. Lyndon A, Lagrew D, Shields L, et al (Eds). Improving health care response to obstetric hemorrhage. (California Maternal Quality Care Collaborative Toolkit to Transform Maternity Care) Developed under contract #08-85012 with the California Department of Public Health; Maternal, Child and Adolescent Health Division; Published by the California Maternal Care Quality Care Collaborative, July 2010

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The Devil in the Details

"First we shape our buildings; thereafter, they shape us."
—*Winston Churchill*

To the Editor:

In the recent article by Wijeysundera *et al.*, the authors demonstrated a significant level of variability in the preoperative testing patterns at different hospitals in Ontario, Canada.[1] Their statistical analyses show that the testing patterns were not explained by the type of surgery, hospital, or patient. However, the authors did not characterize the types of preoperative evaluation processes (*e.g.*, physician-based, nurse-telephone, web-based intake, on-site clinic, etc.). This is important because multiple preoperative assessment systems have been developed; it would not be surprising to find a myriad of systems in one Canadian province. Historically, these clinics were developed because of financial pressures