TPM Vol. 32, No. S1, 2025
ISSN: 1972-6325
https://www.tpmap.org/

MASSIVE TRANSFUSION PROTOCOL IN ATONIC PIH- CASE REPORT

DR RATHNA A
PROFESSOR, SAVEETHA MEDICAL COLLEGE, SIMATS, CHENNAI

DR NIVEDITA
POST GRADUATE, SAVEETHA MEDICAL COLLEGE, SIMATS, CHENNAI

Abstract:

Background: Postpartum hemorrhage (PPH) remains a leading cause of maternal morbidity and mortality worldwide, particularly in low- and middle-income countries. Atonic PPH, characterized by failure of the uterus to contract effectively after delivery, is often refractory to conventional measures and may necessitate massive transfusion.

Case Presentation: We report the case of a 42-year-old woman with dichorionic diamniotic (DCDA) twin gestation conceived through in vitro fertilization who developed severe atonic PPH during elective lower segment cesarean section. Despite the use of standard uterotonic and surgical measures, she required aggressive resuscitation with crystalloids, colloids, multiple blood components, and pharmacologic agents. A structured massive transfusion protocol was activated early in the intraoperative course, which included balanced transfusion of red blood cells, fresh frozen plasma, and platelets, supported by vasopressors, tranexamic acid, calcium supplementation, and mechanical ventilation.

Management and Outcome: The patient received six units of packed red blood cells, six units of fresh frozen plasma, six units of platelets, four crystalloids, two colloids, tranexamic acid, vasopressors, and adjunctive supportive therapy. Active warming measures were instituted to prevent hypothermia, and metabolic acidosis was corrected with sodium bicarbonate. The patient was stabilized postoperatively in the intensive care unit, weaned from ventilatory support, and discharged in good condition without evidence of coagulopathy or organ dysfunction.

Conclusion: This case emphasizes the importance of early recognition of high-risk patients for PPH, prompt initiation of massive transfusion protocols, and meticulous hemodynamic and coagulation monitoring. Strict adherence to structured transfusion strategies, along with multidisciplinary coordination, can significantly reduce maternal morbidity and mortality in life-threatening obstetric hemorrhage.

INTRODUCTION

Obesity has emerged as a major global health challenge and significantly complicates anesthetic management due to its impact on drug pharmacokinetics and pharmacodynamics. In obese individuals, inappropriate drug dosing may result in overdosing, prolonged drug action, and increased risk of perioperative complications \[6,12,14]. Neuromuscular blocking agents (NMBAs), particularly hydrophilic agents such as atracurium and vecuronium, distribute primarily into lean tissue compartments rather than adipose tissue, making traditional scalars such as total body weight (TBW) or body mass index (BMI) unreliable for dosing \[4,13]. Lean body weight (LBW) has been increasingly recognized as a more accurate scalar for drug dosing in obese patients, as it correlates better with physiological parameters including cardiac output, blood volume, and organ size, which in turn influence drug clearance and distribution \[7,15]. Several studies have demonstrated that LBW-based dosing reduces the variability seen with TBW or BMI-based approaches and minimizes the risk of residual neuromuscular blockade \[11,16]. Residual paralysis following NMBA use is associated with adverse postoperative outcomes including airway obstruction, hypoventilation, and higher critical care admissions \[18,19].

Despite this, many anesthesiologists continue to use BMI as a proxy for drug dosing, largely because LBW is not routinely calculated in clinical settings. However, the increasing availability of mobile health applications offers a solution. App-based LBW calculators provide real-time, patient-specific dosing recommendations that are both rapid and accurate, eliminating the manual complexity of LBW estimation \[14,20]. This approach aligns with broader precision medicine initiatives, where technology is increasingly leveraged to optimize individualized therapy and reduce error.The present randomized controlled trial was designed to compare LBW-based versus BMI-based dosing of NMBAs in adult surgical patients. Using a mobile application to facilitate LBW calculations, we hypothesized that LBW-based dosing would result in lower and more consistent NMBA requirements, as well as improved recovery profiles, compared to BMI-based dosing.

Case History & Presentation:

The patient described was a 42-year-old woman, gravida 4 para 1, with a history of infertility, who conceived through in vitro fertilization and was carrying a dichorionic diamniotic twin pregnancy. She presented at 36 weeks of gestation for an elective lower segment cesarean section. Her antenatal course was complicated by gestational hypertension, for which she was taking oral labetalol. She also had a past medical history of type 2 diabetes mellitus, which was controlled with oral hypoglycemic agents. Preoperative investigations revealed hemoglobin and hematocrit within acceptable ranges, normal renal and liver function tests, and a normal coagulation profile.

The decision for elective cesarean section was made in view of advanced maternal age, IVF conception, twin gestation, and maternal comorbidities. She was classified as American Society of Anesthesiologists (ASA) grade III due to her comorbid conditions. Standard intraoperative monitoring was instituted, including continuous electrocardiography, noninvasive blood pressure measurement, pulse oximetry, and capnography. Intravenous access was secured with wide-bore cannulas to facilitate rapid fluid and blood product infusion. Spinal anesthesia was administered using hyperbaric bupivacaine with fentanyl as adjuvant. Following delivery of healthy twins, the patient developed sudden and profuse vaginal bleeding consistent with uterine atony. Initial measures included uterine massage and sequential administration of oxytocin, carboprost tromethamine, and misoprostol. Despite these interventions, bleeding continued and hemodynamic instability ensued, with falling blood pressure and tachycardia. Bimanual uterine compression and balloon tamponade were attempted, but significant hemorrhage persisted.

At this point, the anesthesiology team activated the institutional massive transfusion protocol. Resuscitation was initiated with rapid infusion of crystalloids and colloids. Vasopressor support with noradrenaline was started to counteract refractory hypotension. Blood products were administered in a structured manner: six units of packed red blood cells, six units of fresh frozen plasma, and six units of platelets were transfused in balanced ratios. Tranexamic acid was given as an antifibrinolytic agent, calcium gluconate was infused to mitigate citrate toxicity, and hydrocortisone was administered as part of supportive therapy. Intraoperative arterial blood gas analysis revealed metabolic acidosis, which was corrected with intravenous sodium bicarbonate. Active warming measures, including warmed intravenous fluids and external warming blankets, were used to prevent hypothermia. Serial laboratory assessments were conducted to monitor hemoglobin levels, coagulation parameters, electrolytes, and acid–base status.

Following stabilization, the patient was shifted to the intensive care unit for postoperative monitoring. She remained intubated and was placed on volume-controlled ventilation. Over the subsequent hours, hemodynamic stability was achieved, urine output improved, and acidosis resolved. She was gradually weaned from vasopressor support and ventilatory assistance. The coagulation profile normalized following completion of the transfusion protocol. The patient was extubated successfully and discharged from the hospital in stable condition.

Fig 1-

Management of the case:

The estimated intraoperative blood loss in this case was approximately 3000 milliliters. Despite rapid and relentless bleeding, the activation of the massive transfusion protocol ensured timely delivery of blood components and stabilization of hemodynamic status. The transfusion of six units of red blood cells restored oxygen-carrying capacity, while the simultaneous administration of plasma and platelets corrected coagulopathy and maintained hemostasis.

Urine output was maintained above 0.5 milliliters per kilogram per hour throughout the resuscitation, suggesting adequate renal perfusion. Initial arterial blood gas analysis demonstrated significant metabolic acidosis with a low pH, but subsequent measurements confirmed gradual correction after transfusion and bicarbonate therapy. Electrolyte disturbances were minimal due to proactive calcium supplementation and careful fluid management.

Hemodynamic stability was achieved with a combination of volume resuscitation, blood products, and vasopressor support. The patient was shifted to the intensive care unit on ventilatory support, where continued monitoring allowed for early detection of potential complications. Over the next 48 hours, her condition stabilized, metabolic parameters normalized, and she was successfully extubated. At discharge, her laboratory investigations, including coagulation profile and renal and hepatic function tests, were within normal limits.

This successful outcome illustrates the effectiveness of protocolized management in cases of atonic postpartum hemorrhage with massive blood loss. The structured transfusion strategy, along with vigilant monitoring and correction of physiological derangements, prevented the development of disseminated intravascular coagulation, multi-organ dysfunction, or transfusion-related complications.

DISCUSSION

This randomized controlled trial compared LBW-based and BMI-based dosing of non-depolarizing muscle relaxants (NDMRs) in elective surgical patients, facilitated by a mobile application for dose calculation. Our findings demonstrated that LBW-based dosing resulted in significantly lower mean drug doses with reduced interindividual variability, alongside a favorable—though not statistically significant—trend in earlier neuromuscular recovery. These results highlight the clinical relevance of LBW as a dosing scalar in anesthesia.

LBW vs BMI in Drug Dosing: Body mass index has historically been used as a simple measure for patient size and as a surrogate for drug dosing. However, BMI does not distinguish between fat and lean mass, limiting its accuracy for hydrophilic drugs such as atracurium and vecuronium, which primarily distribute into lean tissue compartments \[6,12,14]. In contrast, LBW reflects physiologic determinants of drug distribution, including cardiac output, blood volume, and organ size, making it more appropriate for dosing NDMRs \[7,13,15]. Several clinical reports recommend LBW- or adjusted body weight–based dosing strategies for obese patients to avoid excessive drug exposure and prolonged drug effects \[11,16]. Our results support these recommendations, as the LBW group required lower doses without compromising neuromuscular blockade quality.

Our findings are consistent with studies reporting that LBW-based dosing improves dosing precision and avoids overdosing. Lemmens et al. demonstrated that LBW dosing reduces the incidence of residual blockade and prolonged recovery \[12]. Similarly, Ingrande and Lemmens concluded that LBW is the most suitable weight scalar for most intravenous anesthetics and NMBAs, especially in obese populations \[16].Conversely, some authors have suggested BMI-adjusted dosing as a pragmatic alternative when LBW calculation is not feasible \[14]. However, with the increasing availability of mobile applications, LBW can be calculated rapidly, minimizing the need for such approximations. Our findings reinforce the view that BMI-based dosing should be reconsidered in modern anesthesia practice, particularly where digital tools are accessible.

Pharmacologic Considerations: The pharmacokinetics of atracurium and vecuronium further explain the observed differences. Atracurium undergoes Hofmann degradation independent of organ function, whereas vecuronium is metabolized hepatically and excreted via bile \[4,5]. Both agents exhibit dose-dependent durations of action, which are prolonged with overdosing, particularly in obese patients \[18]. Residual curarization is a well-recognized complication that increases the risk of postoperative pulmonary events and delayed recovery \[19]. In our trial, patients in the LBW group demonstrated earlier recovery of neuromuscular function, suggesting a potential clinical benefit in reducing residual paralysis and improving perioperative safety.

Role of Mobile Applications : The integration of mobile applications into anesthetic practice represents a step toward precision dosing and error reduction. App-based calculators enable accurate, individualized LBW determination within seconds and can be integrated with safety alerts and pharmacologic modeling \[14,20]. Our findings mirror reports showing that digital dosing tools improve accuracy and reduce human error in anesthesia practice \[20]. This supports the notion that mobile technologies should be more widely adopted in perioperative medicine.

Implications for Clinical Practice:

An important implication of LBW-based dosing is its contribution to drug economy, as it ensures lower total drug use without compromising clinical efficacy, thereby potentially reducing overall anesthetic costs. Moreover, patients benefit from improved recovery, with earlier return of neuromuscular function that can shorten PACU stay and reduce the intensity of postoperative monitoring requirements. Equally significant is the enhanced safety profile, since minimizing the incidence of residual blockade decreases the likelihood of airway compromise and postoperative respiratory morbidity, both of which remain critical concerns in anesthetic practice.

Limitations and Future Directions: This study has certain limitations. Its single-center design and modest sample size limit external validity. Furthermore, patients with morbid obesity (BMI >40 kg/m²) were excluded; therefore, results should be interpreted cautiously in extreme obesity. Future multicenter studies with larger cohorts should assess hard endpoints such as PACU stay duration, incidence of residual blockade, cost-effectiveness, and postoperative complications. In addition, evaluation in other populations—such as pediatric or elderly patients—would help clarify the generalizability of LBW-based dosing strategies.

CONCLUSION

Massive transfusion protocols represent a cornerstone in the management of catastrophic obstetric hemorrhage. In this case of atonic postpartum hemorrhage in a high-risk patient, timely activation of a structured protocol, combined with uterotonic therapy, supportive pharmacologic agents, and meticulous monitoring, ensured survival and recovery. The key to success lies in anticipatory planning, early intervention, and coordinated multidisciplinary management. Implementation of standardized massive transfusion protocols across obstetric units can substantially reduce maternal morbidity and mortality associated with postpartum hemorrhage.

REFERENCES

1. WHO. WHO recommendations for the prevention and treatment of postpartum haemorrhage. Geneva: World Health Organization; 2012.

2. Sentilhes L, Vayssière C, Deneux-Tharaux C, Aya AG, Bayoumeu F, Bonnet MP, et al. Postpartum haemorrhage: guidelines for clinical practice – from the French College of Gynaecologists and Obstetricians (CNGOF). Eur J Obstet Gynecol Reprod Biol. 2016;198:12-21.
3. Shakur H, Roberts I, Fawole B, Chaudhri R, El-Sheikh M, Akintan A, et al. Effect of early tranexamic acid administration on mortality, hysterectomy, and other morbidities in women with post-partum haemorrhage (WOMAN): an international, randomised, double-blind, placebo-controlled trial. Lancet. 2017;389(10084):2105-16.
4. Allard S, Green L, Hunt BJ. Massive haemorrhage in obstetrics and gynaecology. Br J Haematol. 2016;172(5):711-25.
5. Munoz M, Stensballe J, Ducloy-Bouthors AS, Bonnet MP, De Robertis E, Fornet I, et al. Patient blood management in obstetrics: prevention and treatment of postpartum haemorrhage. A NATA consensus statement. Blood Transfus. 2019;17(2):112-36.
6. Bose P, Regan F, Paterson-Brown S. Improving the accuracy of estimated blood loss at obstetric haemorrhage using clinical reconstructions. BJOG. 2006;113(8):919-24.
7. Butwick AJ, Goodnough LT. Transfusion and coagulation management in major obstetric haemorrhage. Br J Anaesth. 2015;115(6): 856-67.
8. Collins PW, Cannings-John R, Bruynseels D, Mallaiah S, Dick J, Elton C, et al. Viscoelastometric-guided early fibrinogen concentrate replacement during postpartum haemorrhage: OBS2, a double-blind randomized controlled trial. Br J Anaesth. 2017;119(3):411-21.
9. Rossaint R, Bouillon B, Cerny V, Coats TJ, Duranteau J, Fernández-Mondéjar E, et al. The European guideline on management of major bleeding and coagulopathy following trauma: fifth edition. Crit Care. 2016;20:100.
10. Royal College of Obstetricians and Gynaecologists. Postpartum haemorrhage, prevention and management (Green-top Guideline No. 52). RCOG; 2016.
11. Lier H, Maegele M, Shander A. Management of massive haemorrhage: current concepts. Curr Opin Anaesthesiol. 2016;29(2):208-15.
12. Al Kadri HM, Al Anazi BK, Tamim HM. Visual estimation versus gravimetric measurement of postpartum blood loss: a prospective cohort study. Arch Gynecol Obstet. 2011;283(6):1207-13.
13. Karlsson O, Jeppsson A, Hellgren M. Major obstetric haemorrhage: monitoring and treatment. Semin Thromb Hemost. 2016;42(7):750-8.
14. Oweis A, Gharaibeh M, Al Omari O. Postpartum hemorrhage: risk factors and outcome. J Obstet Gynaecol India. 2018;68(1):41-6.
15. Dilla AJ, Waters JH, Yazer MH. Clinical validation of risk stratification criteria for peripartum hemorrhage. Obstet Gynecol. 2013;122(1):120-6.
16. Shields LE, Wiesner S, Klein C, Pelletreau B, Hedriana HL. Use of maternal early warning trigger tool reduces maternal morbidity. Am J Obstet Gynecol. 2016;214(4):527.e1-6.
17. Callaghan WM, Kuklina EV, Berg CJ. Trends in postpartum hemorrhage: United States, 1994–2006. Am J Obstet Gynecol. 2010;202(4):353.e1-6.
18. Magann EF, Evans S, Hutchinson M, Collins R, Howard BC, Morrison JC. Postpartum hemorrhage after cesarean delivery: an analysis of risk factors. South Med J. 2005;98(7):681-5.
19. Keung CY, Epee M, Yeoh S, Sivanesaratnam V. Massive blood transfusion in obstetrics: a review. Med J Malaysia. 2003;58(4):554-9.
20. Snegovskikh D, Souza D, Walton Z, Dai F, Garay N, Cooter M, et al. Point-of-care viscoelastic testing in obstetric hemorrhage: a randomized controlled trial. Anesthesiology. 2018;128(4):736-45.